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ON THE COVER: The E-flite Convergence VTOL is a unique flier that can take off like a multirotor and transition to forward flight. Our exclusive review is on page 46. (Photo by Cheryl Vomacka Maltby)

THIS PAGE: The Great Planes Zero Sport looks terrific and would make an excellent first warbird. (Photo by Michael York)

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Preflight

BY DEBRA CLEGHORN | EXECUTIVE EDITOR

The Latest in RC

Since 1929, *Model Airplane News* has covered the latest and greatest in model aviation, from the first reed radio systems to brushless motors and flight-stabilization systems. This month, we're excited to review another model that features the latest in RC technology: E-flite's Convergence. This vertical takeoff and landing (VTOL) airplane can hover, take off, and land vertically as well as fly forward using its wing to generate lift. We found the Convergence to be very easy to fly, and our West Coast Senior Editor John Reid was impressed by how seamlessly this plane can transition from hover to forward flight and back. Check your digital edition (available to all print subscribers) or go to ModelAirplaneNews.com to see this incredible aircraft in flight!

FIRST STEPS

Everyone has his or her own personal reason for taking up RC flying as a hobby. Maybe you built models with your dad or granddad (who may have subscribed to *Model Airplane News*—we've been in publication since 1929!). Maybe you enjoy sharing the hobby with your own children. Many RC hobbyists come out of the military (thank you for your service) or the aviation industry. Others just have a passion for flight. Whatever your reason, if you're new to this hobby, we have two must-see articles for you. In "18 Top Trainers," our panel of experts helps you make the all-important choice of your first plane, drone, or helicopter. A good first RC aircraft is a critical choice, and all the planes, drones, and helicopters we highlight are best bets to help you successfully earn your wings. And after you've chosen that all-important first aircraft, our second feature, "First-Flight Success: Tips and Techniques to Master the Skies," will ensure that you get off to a flying start. If this is your first issue of *Model Airplane News*, we warmly welcome you to this fantastic sport. If you're a longtime subscriber, we hope that you'll share this magazine with someone who hasn't yet experienced the thrill of RC flight.

SEE YOU ON THE FLIGHTLINE

I hope you'll enjoy this May issue and will continue to email us at MAN@airage.com with your comments, suggestions, and latest projects. Your feedback helps us continue to make *Model Airplane News* the industry's premier RC airplane magazine.



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Est. 1929 **NEWS**

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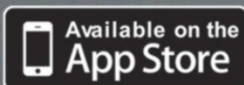
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We love hearing from our readers: Your emails, tweets, and comments quickly let us know what you'd like to see more (or less!) of in upcoming issues and online. Here's what some of you are saying about *Model Airplane News* magazine.



ModelAirplaneNews.com | RV-4 Makeover

Many of today's ARFs are of good quality, but they all suffer from one issue: an excessive amount of "sameness"! Our good buddy and longtime MAN contributor Carl Layden did a covering makeover on his Great Planes RV-4. As you can see, he did an amazing job, with a MonoKote finish that completely transformed the model's everyday looks. Here's what some of you had to say.

Chris Griffin: This reminds me of my dad's. Really nice aircraft!

Mark Stotsky: Sending you mine for a makeover!

Adam Murphy: My girlfriend's dad is a serious RC guy, and he does this kind of stuff all the time. Nice job.

Ronald Thompson: I've read some of Rich Uravitch's makeover articles in MAN, and this is the first civilian plane I've seen made to look even better. Thanks for the great articles.

William Taylor: You can't argue that a good re-cover will improve your model's looks. Well done.

George Louis: My RV-4 is looking pretty ratty. I think I'll try this and see what happens.

f Facebook | Photo of the Week

A regular part of the MAN Facebook page is our Photo of the Week. We recently posted this great shot of David Wigley's amazing Bristol Beaufigther. David designed and scratch-built his amazing RAF warbird and won first place in the Masters class as well as the title of Mr. Top Gun at the 2013 Top Gun Scale Invitational in Lakeland, Florida. Several of you had good things to say.



SC: Oh! I saw Dave's Beaufigther go in at Top Gun. I do hope he plans to rebuild it.



MY: At first, I thought it was a German bomber in British markings. I looked it up, and I am amazed Mr. Wigley scratch-built such an amazing and unusual twin-engine warbird. Kudos!



RJ: There are some amazing airplanes that show up at Frank Tiano's Top Gun contest. Please keep these great photos coming.



NS: David Wigley is an amazing airplane designer, builder, and RC pilot. This one is my favorite of all the scale masterpieces he has created.

✉ In Our Mailbox | Sopwith Camel Plans

I am very happy as I just received your plans for the quarter-scale Sopwith Camel. I read about it in your December 2015 issue, and I also followed your online Build-Along stories on ModelAirplaneNews.com. The plans look great. I was wondering if you have any suggestions not covered in your construction article, and maybe get a tip or two on how it flies. I am thinking about doing the Lt. Roy Brown paint scheme, and I am looking forward to getting started.—Ricky Davison, Sunland, CA

Thanks for writing, Ricky. I had a great time designing and building the Camel, and after many successful flights, I can say that it is a rugged, stable, good-flying sport plane. Considering that it has a fixed tailskid, it has decent ground handling, too. One thing I've come to learn is that the G-38 engine has plenty of power, but if you don't go crazy with the detailing and covering material, any good 25–30cc gas engine will do fine. As for flying tips, remember to use rudder in the turns. Adding a mix for aileron differential (20%) and a little aileron-to-rudder mix will make the Camel well behaved. Also, keep the nose down on final approach, and don't chop the power until you are just about ready to flare.—GY





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Tips & Tricks

USEFUL HINTS FROM MODELERS | Illustrations by Richard Thompson



POCKET SQUARE

When building your model's wing, it is important to keep the ribs square (90 degrees) to the workbench to maintain the proper airfoil shape. I have found that old plastic credit cards with slightly rounded corners make handy 90-degree building guides and are easy to clean should you get any glue on them. You can also use them to maintain rib alignment with the main spar, or any other building task where two parts need to be square to each other.

Danny Carozza, Yonkers, NY



EASY ORGANIZER

Working on any project is easier if you stay organized; plus, if you don't have loose hardware on your workbench, you will greatly reduce hangar rash on your airplane. I have been using an old recyclable egg crate as a handy parts holder, and it works great. When it's open, there's room for hardware, and hand tools can be set on the lid. When you're done for the evening, simply close the egg crate and store the hardware for next time.

Aaron Ham, Sherman, CT

ANTI-ROLL

It happens all the time: While working on your model, you set your hobby knife down and it promptly rolls off the workbench. If you're lucky, your foot is not in the way, but at the very least, you'll have to replace the blade as it always seems to hit the floor blade first. Here's a simple fix: Take a cable tie and tighten it on the handle and then cut off the tail. The little locking nub will prevent the knife from rolling.

Henry Haffke, Scotia, NY



SLOT CLEANER

After you cut the slots for your model's hinges, there's usually some debris left behind. I have found that the emery boards used to file fingernails work great to clean up and smooth the inside of the hinge slots. The boards are available in assorted grits; I find that the coarse grit works best.

Faye Stilley, Wilton, CT



SEND IN YOUR IDEAS! We want your ideas for Tips & Tricks! This month's winners will receive a *Model Airplane News* baseball cap. Send a photo or rough sketch and a brief description to MAN@airage.com or *Model Airplane News*, c/o Air Age Media, 88 Danbury Rd., Wilton, CT 06897 USA.

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SUPER CUB

**Jean Chevalier,
Lacolle, QC, Canada**

In an interesting twist, the paint scheme on this 75 percent Super Cub is modeled after its smaller brother! After buying the plain yellow homebuilt, Jean decided to outfit it to look like that of his 1/3-scale Balsa USA model. Jean notes that it only took a few weeks to paint the colored stripes and apply the graphics on the person-carrying plane. Nicely done!



CANADIAN 150TH ANNIVERSARY EXTRA

**Jeremy Dann,
Kentville, NS, Canada**

Built from a Great Planes kit, this 11-pound Extra 300S is powered by a Leopard motor, a 100-amp speed control, and a 6S 5000mAh LiPo battery. Control is provided by a Spektrum DX9 transmitter and Hitec Karbonite servos. Jeremy notes, "It flies really well and required zero trimming, which is always a nice surprise."



PIETENPOL

Terry Ziegler, Moline, IL

After scratch building this 1/3-scale model in the early '80s, Terry sold it to a friend, who eventually returned it to him 30 years later. The restored aircraft is powered by a U.S. Engines gas engine, is covered in fabric, and has scale pull-pull linkages.



J-3 CUB

**Robert Kohler,
Idaho Falls, ID**

This Goldberg 1935 Anniversary Cub is the handiwork of Robert and his sons, who built it from a kit and added functioning flaps, stronger landing gear, and rotated the engine. The 76.5-inch-span model is powered by a Magnum .61 two-stroke engine, and Robert writes, "Its first flight went wonderfully."

SEND IN YOUR PICTURES! Model Airplane News is your magazine, and we encourage reader participation. Email your high-resolution images to MAN@airage.com, with your contact information and details on your project. Every pilot we feature will receive a Model Airplane News baseball cap, and the "Pilot Project of the Month" winner will receive a Model Airplane News "swag pack."



The whole Hog.

Like the legendary US jet, the all-new **FMS A-10 Thunderbolt II 70mm EDF, 1500mm PNP** was built to make a thunderous statement. Powered by dual 70mm electric ducted fans (EDF), the "Hog" combines brute strength with confidence and stability. With all-around rivets and panel lines, a scale pilot, and detachable bomb and missile sets, the FMS A-10 is a plane that warbird enthusiasts will gush over. Quick field assembly means you'll be making strafing passes in no time. **Learn more at [ForceRC.com](https://www.force-rc.com).**

Great Planes Ultra Sport 46

For longer than we can remember, the Ultra Sport has been a flightline favorite for its great looks, style, and performance. Now you can fly the latest ARF version with a .46-.55 two-stroke or a .70 four-stroke engine, or an electric motor equivalent. Features include mechanical retracts, symmetrical airfoil, and a large hatch for easy access to the interior. This built-up, 55-inch-span model costs \$199.99. greatplanes.com



Blade 130 S

Don't be fooled by its submicro size; this 3D helicopter has power and performance to please even intermediate and advanced pilots. Equipped with SAFE Technology, its self-stabilization, panic switch, and three progressive flight modes will let you master 3D moves indoors and outside. The BNF version is \$199.99, and the RTF is \$249.99. bladehelis.com



Hitec Phantom X4 Charger

If you fly a DJI Phantom 3 or 4 drone, this 4-channel battery charger will keep you airborne longer. The X4 will charge, storage-charge, and deep-cycle four Phantom 3 and 4 Smart Batteries simultaneously as well as charge two smart devices via USB ports. This sophisticated \$224.99 charger allows you to spend more time flying and less time waiting for batteries to charge. hitecrctd.com



Hangar 9 Ultra Stick 30cc

Everyone likes an Ultra Stick, and we love this giant, 80.75-inch-span version. Extra-large, double-beveled control surfaces are made for 3D moves, and optional quad flaps offer the ultimate in slow-flight capability. This built-up aerobat can be powered by a 33GX gas engine or electric motor equivalent, and it costs \$299.99. hangar-9.com



E-flite Valiant 1.3m

With the stability of a high-wing classic model and the sleek lines and sporty response of a modern aircraft, the Valiant has a wide flight envelope. Made out of durable Z-Foam, it comes with a 480 brushless motor and servos installed and with functional flaps. Add the optional floats and you can fly off water! The PNP version is \$179.99, and the BNF Basic is \$199.99. e-fliterc.com



ICARE Fusion

If you like sleek, screaming-fast models, you'll love the Fusion. This all-molded plane is available in a pusher-prop configuration or with a top-mounted fan unit for electric or turbine power. This 31-inch-span speedster has plenty of carbon-fiber reinforcement and comes in a variety of color schemes. The Fusion starts at \$399.00. icare-icarus.com



Blade mSR S

Step up to single-rotor performance with this micro model. Its fixed-pitch, flybarless rotor provides speed and agility, and its included 1S 150mAh LiPo has a 45C discharge rate for responsive power. SAFE Technology and AS3X stability will ensure your flight success. The BNF version is \$99.99, and the RTF is \$119.99. bladehelis.com

E-flite UMX Waco BL

Everyone knows airplanes aren't cute, but this micro biplane comes pretty darn close. With just a 21.7-inch wingspan, this model of the classic comes with surfaces details molded in as well as carbon-fiber flying wires, windcreens, pilot figure, and more. Its built-in AS3X flight stabilization makes it fly like a much larger model, even in wind. This BNF Basic model costs \$129.99. e-fliterc.com



A silhouette of a man holding a large model airplane against a sunset background. The man is standing in the center, holding the airplane horizontally in front of him. The background is a bright, hazy sunset with orange and yellow clouds. The man is wearing a t-shirt and cargo pants, and is holding a bag in his left hand.

FIRST-FLIGHT SUCCESS

TIPS AND TECHNIQUES TO MASTER THE SKIES

BY THE *MODEL AIRPLANE NEWS* CREW

Today is a great time for the first-time RC modeler to get started in the hobby. The newest generation of easy-to-assemble, almost-ready-to-fly planes, helicopters, and quadcopters come in a wide variety of types and sizes. From electric-powered park fliers, microscale airplanes, and basic e-powered trainers to helicopters and the new crop of multirotor camera drones, the amount of workbench time to get them from the box and into the air is minimal. Many even come out of the box completely ready to fly without any assembly required. Really, the hardest part of getting started is actually deciding which type of model you want. Let's take a look at some of the basic techniques that you'll need to know to become successful.



Above: Going to your local hobby shop is a good first step. There, you'll learn more about the hobby and what types of models are available. Right: There are a lot of online sources for information, including ModelAirplaneNews.com and our Getting Started section.



GET YOUR CARD

Once you are committed to becoming an RC pilot—regardless of the type of aircraft you want to fly—you should become a member of the Academy of Model Aeronautics (AMA). The AMA is the national organization that deals with all things in the RC model aircraft world. The organization is an excellent information resource, and it also offers insurance to its members to cover liability issues should something unforeseen happen. For more information on becoming a member, visit the organization's website: modelaircraft.org.

All AMA members (and anyone else for that matter) are required to register their aircraft (also known as "unmanned aircraft system," or UAS) with the Federal Aviation Administration (FAA). RC modelers must register online any UAS weighing more than 0.55 pounds; the registration fee is \$5. Registration can be accomplished on the FAA webpage at registermyuas.faa.gov. The AMA staff and leaders are always working with the FAA to stay informed of all current and future governmental requirements that will affect the hobby and the aircraft flown for recreation as well as commercial use.



Getting Started with Model Airplanes

If you are the social type who enjoys talking about RC planes as much as learning how to fly them, check out the many online resources and see what piques your interest. From there, check and see if there's a local hobby shop in your area. There, you can get to see up close what's available and learn more from the store's staff about how they work. Also, joining a local club is a great way to go. Meeting and talking to other like-minded RC people is a lot like group therapy. Usually clubs also have a permanent flying field, and cost of membership is relatively inexpensive compared to the benefits you receive. Being a club member, you'll quickly find out where local modelers hang out and find useful hobby resources.

To get your fixed-wing rating, there are many great trainers available in different sizes and power systems. For the most part, electric-powered airplanes are less complicated and can be made flight ready in almost no time. But they are a bit more expensive than the traditional glow-engine-powered trainers of the same size. Again, check what's available and what the local guys are flying and make your choices accordingly.

During your first few flights, try to form a training plan with your instructor. Each of your flights should have a specific goal and build on what you've learned from your previous flights. Again, you can try to learn all by yourself, but it will take you a lot longer to master the basics. First, learn to taxi around; while on the ground, you can also practice steering with the rudder and working the throttle smoothly. After you become more comfortable with controlling your plane on the ground, you can move to takeoff and straight and level flight. After you get the hang of it, your instructor will get your airplane up to altitude, and you can start flying and learning to turn and manage your airplane in the traffic pattern.

There are plenty of choices when it comes to fixed-wing model aircraft. All it takes is some practice, and you'll be able to solo in no time.



FIRST FLIGHT

As you gain experience and can begin to anticipate your model's needed corrections, your instructor will eventually give you more "stick time" until he feels you're ready to solo. Usually this sneaks up on you and before you know it, you'll be ready.

Takeoffs are actually the easiest part of the flight. Most trainer planes are stable, and when you fully advance the throttle, they'll get airborne and climb almost by themselves as long as you keep them under control and on a straight path. Apply throttle slowly, and should it veer one way or the other, correct the steering with a touch of rudder. As the model gets light on its feet, pull back slightly on the elevator stick; the model will nose up and become airborne. Pay attention to keeping the wings level

with slight aileron corrections, and maintain a shallow climbing angle. If the climb gets too steep, the model can stall, so ease off a little on the up-elevator, and if necessary, you might even need to add a little down-elevator to keep a steady climb angle.

Your instructor will then teach you to turn and fly in the traffic pattern around the flying field. Eventually, he'll let you fly at low and lower altitudes as your skill and comfort levels improve. A good instructor will talk you through the landing pattern and get you lined up for your first attempts with a minimal amount of help. You'll learn to control airspeed with elevator (model nose-high or nose-low) and adjust your descent rate with throttle. Once you make that very first (a little scary) landing, it won't take a lot of time before you can solo and then fly unassisted.

ANATOMY OF A RADIO

AN INSIDE LOOK AT HOW RC TRANSMITTERS WORK

As you become more involved with the hobby and the sophistication of your models increases, you will get to a point where you will start using higher-quality radio systems. Many ready-to-fly models come with a dedicated transmitter that's programmed to work with that aircraft. For models that are built from kits or come in almost-ready-to-fly or bind-and-fly packages, you'll have to supply your own transmitter.

All modern radio systems operate on basically the same principles and differ mostly with how their programming menus are navigated. Most will have specific menus for airplanes, helicopters, and multirotor aircraft. Relatively simple in operation, transmitters (and their internal components) can be a little intimidating for first-time user. Let's take a look at what their main parts are, where they're found, and what the basic functions are. For our example, we are using a Futaba 10J transmitter (futaba-rc.com).

Power Switch

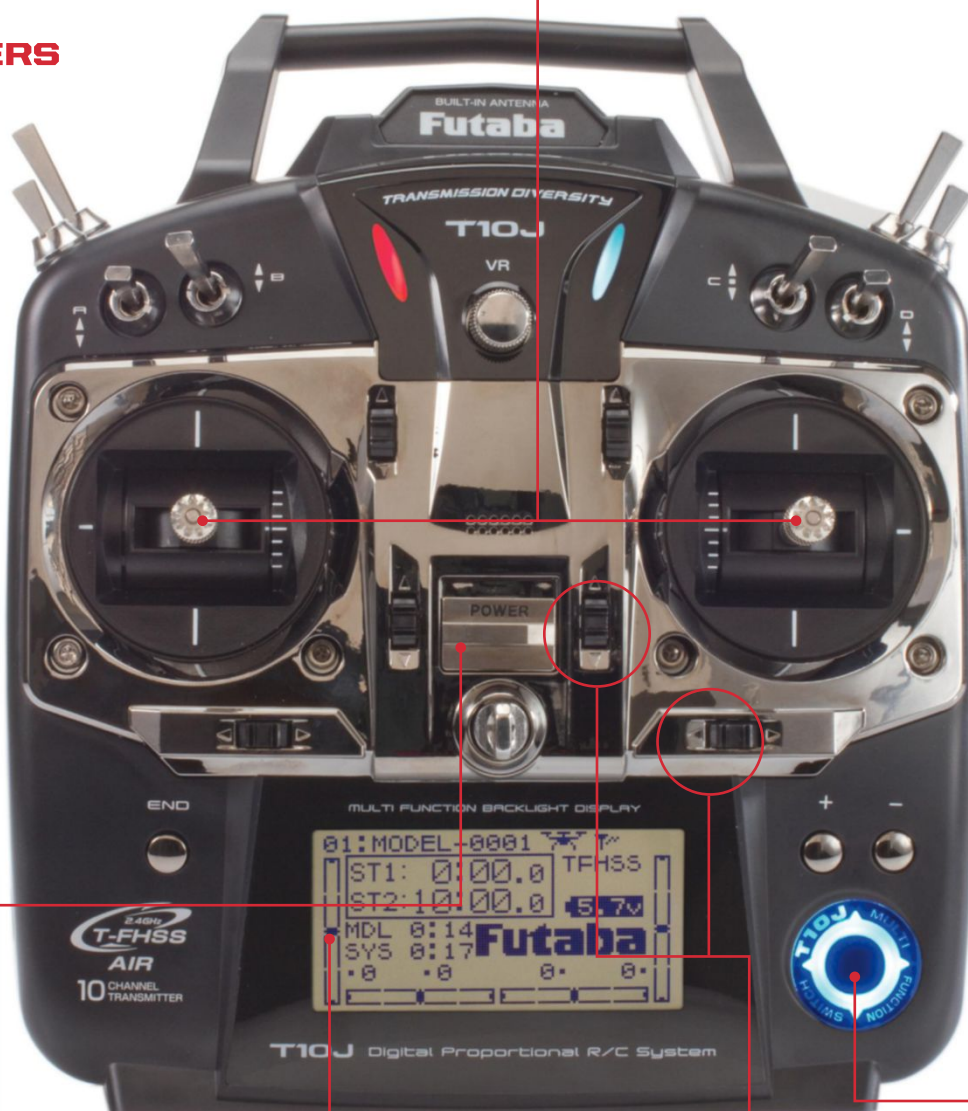
All transmitters have a main power switch for turning the radio on and off. Some transmitters have a program-menu option to turn on with or without the radio signal being transmitted. This is helpful for setting up your radio's programming.

MAIN DISPLAY SCREEN

This LCD screen is the window into your radio's programming. It is where you navigate to the various programming functions and options, and it also provides important information while you are operating your multirotor. Basic information that is shown on the main screen includes the model type, name, and number; the transmitter battery voltage; the type of signal modulation selected; user countdown or count-up timers; and graphic bars to show the various trim-lever positions. There are several submenus also available for specific control functions and programming parameters. There may also be a graphic for telemetry receiving accuracy if your transmitter has that capability.

Control Sticks

There are two main control sticks. The left stick (mode 2 setup) controls the power and the yaw response (nose left and right). If you were inside a cockpit, the left stick takes the place of the throttle control and rudder pedals. The right control stick is like the main control column or joystick that would be between your legs in the cockpit. For an airplane, it controls the ailerons (roll) axis and the elevator (pitch) axis. With a quadcopter or helicopter, by moving the right stick you control the left/right movement of the model as well as the forward/aft movement.



Control Trim Levers

Close to the control sticks are small switches that may be used to "trim," or offset, the neutral position of each of the control functions. These trims adjust the center neutral position of each control function (or, in the case of the throttle control, the idle position) and allow you to fine-tune your aircraft's response. When the control stick is centered but the model wants to drift to the left/right or forward/backward, the trim levers are used to bring the model back to a solid and consistent flight path or hover.

ON THE INSIDE

Inside the transmitter case are the various circuit boards, wiring, and electronic items that transmit the radio frequency; vary the signal modulation that, in turn, controls the multirotor; and, if so equipped, receive telemetry data from the multirotor.

Switches

Transmitters are equipped with an assortment of two- and three-position switches located at the two upper corners of the case. These switches allow you to change from a variety of settings, including dual rates and exponential control as well as auxiliary functions. You can also activate various flight modes and programmed mixes among the controls. Basic radios have fixed switch functions, with the switches labeled to identify their functions. More advanced radios provide you with the flexibility to assign different functions, flight modes, and mixes to the switches you want.

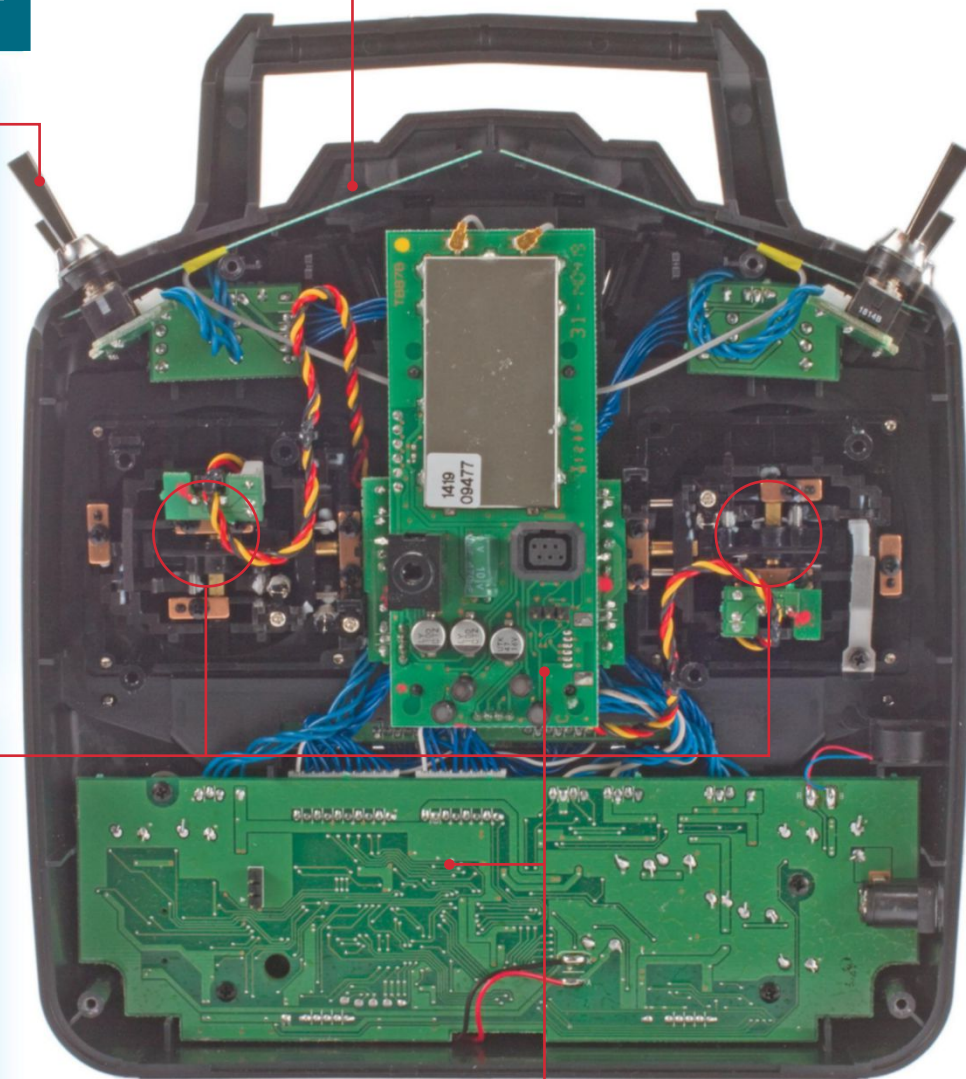
Control Gimbals

The base of each control stick is connected to a movable gimbal assembly. These spring-loaded (except for throttle), self-centering components read the position of the control stick and send that information to the control board, which, in turn, determines the appropriate control commands and sends them out via the signal-modulation circuitry. Moving the sticks changes the signals transmitted to the airborne receiver in the model.

MULTIFUNCTION SWITCHES AND KEY BUTTONS

These are used to select and adjust the various program-menu items. By pressing or by pressing and holding these buttons and switches, you bring up the submenus for the radios and the function and system items. Each radio system comes with a detailed instruction manual describing each function and program option. In its most basic form, this is how you select the type of model function you want, how you name the model, and how you to set up your controls specifically for the safe and precise control of your chosen aircraft.

Antenna The antenna that transmits the radio signal to the model can be internally or externally mounted. Some newer transmitters have the antenna incorporated into the transmitter's handle. Depending on the radio's systems, single or dual transmitter antennae may be used.



Circuit Boards

Divided into several main and subboards, the green PC boards are the brains of the transmitter. All the integrated circuits, switches, and wires are connected to the PC boards. The boards manage the power delivered to the radio's programmable EPROM, which is a type of memory chip (shown at right) that retains its data when its power supply is switched off. In other words, it is nonvolatile, and it is the integrated circuit that retains the settings that you program using the main display.





THE BUDDY SYSTEM

The best way to learn how to fly is with a buddy-box system. Many of today's radios include a built-in wireless buddy system where the instructor's and student's transmitters can be tied together. This allows the instructor to take over control of your airplane by releasing the trainer switch. Should you get into trouble, your instructor can then make any corrections to right the plane and then give the control back to you. Available from many radio manufacturers, buddy-box training systems are also often available from RC airplane clubs. Having someone help you avoid those first few mistakes will greatly speed your learning curve, and it is completely possible to solo with one airplane if you have the help.

Today's buddy-box training systems are wireless and come built in to similar brands of transmitters. The instructor can take control when required simply by releasing a spring-loaded trainer switch.

HAVING SOMEONE HELP YOU AVOID THOSE FIRST FEW MISTAKES WILL GREATLY SPEED YOUR LEARNING CURVE.

VIRTUAL FLIGHT TRAINING

Today, a lot can be learned with the use of good flight-simulator programs. These are available with all sorts of models in their menu, and you'll usually be able to find one at a hobby shop that you can try out. Although nothing speeds your progress more than some one-on-one time with an experienced modeler who flies the same type of model you want to fly, flight sims are great for getting the feel of flying RC models. They help you form basic eye-hand coordination and will help you start anticipating what the airplane is going to do on your first few outings. Sims are very good tools to start with, and this approach will also save you some cash as you'll avoid having to buy a new plane after a crash.

Besides airplanes, today's flight sims also have multirotor and quadcopter models built into their programming. It's a simple matter to load up a quadcopter or other type of multirotor craft and see how things work. For helicopters especially, these photo-realistic flight sims are great for mastering the basics of heli flight. Helicopter pilots must master the constant coordination required of all four primary controls, and until you train yourself to do this subconsciously, moments of confusion or outright "brain lock" are par for the course. Not just a tool for beginners, modern flight sims are also an important practice aid for the most experienced advanced heli fliers.

Flight-simulator programs are great training tools and you can find them at most hobby shops. Some shops have a display with a simulator running so that you can try it out.



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Getting into Drones

Drones seem to be everywhere these days, and you'll find them at just about every flying field across the country. If you're interested in them and want to see what all the excitement is about, just stop by the hobby shop. They're a different kind of flying model, however, and at first, you might not know where to start. Let's discuss some basic steps on how to get started.

In many respects, flying drones is similar to flying airplanes. Both use a familiar two-stick transmitter, and the control inputs are also similar. The differences, however, will take some getting used to as controlling drones is more similar to flying helicopters.

For most drones, the left stick is for the throttle (going up and down), and rudder control for yawing nose-left and nose-right. The right stick is for the elevator and aileron control for forward/back and side-to-side movement. First, use a flight simulator to get used to the controls. While the drone models in the sim might not react exactly as real-world multirotors do, they will be close enough to get your eyes and hands accustomed to flying drones. (You've got to love that Reset button when things go south.) Once you can control these virtual drones with confidence, it's time to try the real thing.



Here's a typical drone controller with a FPV mobile-device holder. This one from Dromida has two control sticks and digital trim levers. Most smaller ready-to-fly quadcopters come with their own controller and accessories included.



With practice, you'll be able to take off and land in the palm of your hand.

START SMALL

Begin with a small, less complicated quadcopter. There are dozens of these smallish mini multirotors available, and they're usually packaged with everything you need. By starting out small, you save money as they're much less expensive than the larger camera drones that are so popular today. Also, because they don't weigh very much, they are somewhat more crash resistant. You really have to drive them into something hard to cause a lot of damage. Usually the person behind the counter at the hobby shop will be able to show you the basics and get you on the right track. There is no real "at the flying field" flight training required.

THERE IS NO REAL "AT THE FLYING FIELD" FLIGHT TRAINING REQUIRED.



Flying small multirotors indoors makes flight training easy and is not affected by bad weather.

INDOOR TRAINING

Another advantage of using mini multirotors is that you can train indoors. This means that, no matter what the weather is like outside, you'll always be able to fly. If you have a large living room or a playroom, move the furniture so that you have a nice wide flying area. Also, the only things that might get damaged while you are practicing are the propellers, so be sure to have an extra set handy just in case. To maximize your flight times, it's worth the expense to buy a couple of extra flight batteries. This way, while one battery is charging, you can still be flying with a fresh pack in your quadcopter.



Getting Better Ideas Off The Ground...

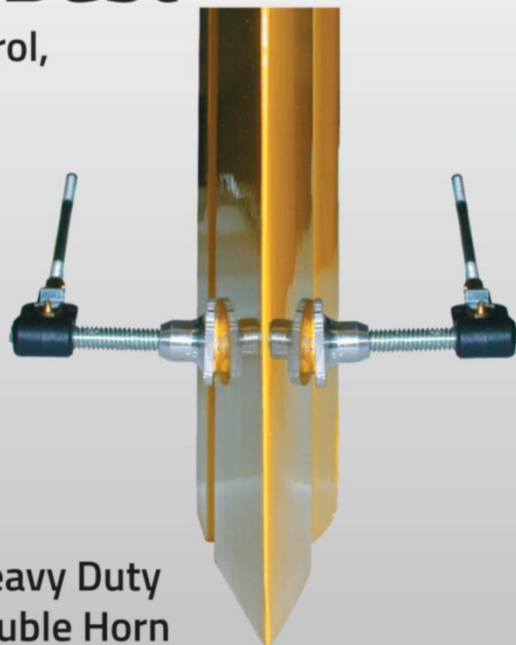
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AND AREN'T
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DIRECTION
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IS FLYING,
SIMPLY
NEUTRALIZE
YOUR
CONTROLS
AND ENTER A
HOVER, REDUCE
THROTTLE, AND
LET IT LAND.**

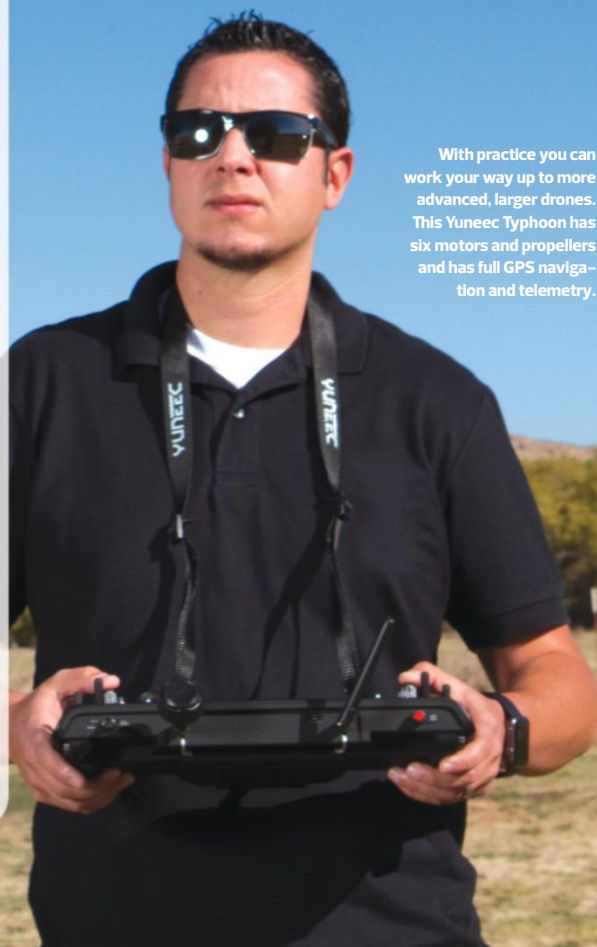
ONE STEP AT A TIME

After reading the instructions and getting accustomed to how your multirotor flier starts and stops, the first thing to learn is how to hover as each of your flights will begin and end in a stable hover. Place a large poster board in the center of the room that you can use as a helipad to take off and land on. The first step is to advance the throttle, hop the quadcopter up a foot or two above the poster board, and then reduce power and land. Try to avoid the urge to choke the throttle if the drone starts going somewhere you don't want it to. This will make it fall to the ground and possibly bust a prop or landing skid.

Using the helipad approach gives you a visual target to help keep you aware of your drone's relative position. If you just take off and try to hover in front of you, you'll soon learn what the term "chase the cat" means. By practicing hovering over your helipad, you'll be more aware of what corrections you need to use to keep the drone over the takeoff zone. Set the control response of your controller to Low (or Beginner) and try to hover for your entire flight at the same altitude over the poster board. When you can do this consistently, you'll be ready for more advanced maneuvers.

Practice first with slow forward flight, going from hover to another hover about 10 to 15 feet away. Do this moving forward and again moving backward back to your starting point. Next, try this moving sideways and return the starting point again. As this gets easier for you, try bumping up the speed and the distance you fly away from yourself. Once this is mastered, you can then explore moving in large flight paths while avoiding obstacles in the room. Try precision maneuvers like figure-8s and square circles.

If your drone is big enough and has enough power, try flying outside during calm conditions. This gives you a lot more space to fly in and get used to how your quadcopter looks when it is far away. Remember that if you get disoriented and aren't sure which direction your drone is flying, simply neutralize your controls and enter a hover, reduce throttle, and let it land. Then go get it while you let your nerves calm down. Stick in a new battery and try again. When you have a good feeling and are comfortable flying outside, then you'll be ready to move up to more advanced drones. And the good thing here is that the larger, more sophisticated drones are actually easier to control and fly because of their GPS navigation.



With practice you can work your way up to more advanced, larger drones. This Yuneec Typhoon has six motors and propellers and has full GPS navigation and telemetry.



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Becoming a Heli Pilot

If you are thinking about taking the step and getting into RC helicopters, you're in for a surprise. Compared to several years ago, there are lots of training options available today. Which one is best for you depends in part on your background, age, and aptitude. If you spent your youth playing Xbox, then you probably already have quicker reflexes and might advance more rapidly. Learning is a lot easier if you can minimize pilot stress, so let's see how we can do that from the start.

FLIGHT TECHNIQUES

For most heli beginners, the hardest task is learning to coordinate all four flight controls. Cyclic isn't too bad because forward stick makes the heli go forward and right stick makes it move right. Rudder is more challenging. Students tend to get it backward because they're watching the wagging tail boom. You should focus on whatever end of the heli that is pointed away from you: For nose-out hovering, focus on the nose, and for nose-in hovering, focus on the tail. It helps if the heli is hovering at a slight angle instead of exactly tail-in. This makes it more intuitive for you to give the correct rudder inputs, thereby reducing the workload on your busy brain and hands.

Once you get the hang of basic hovering, you're ready for slow forward flight. Begin by going to a relatively large open space. In an open space, you can ease into forward flight by flying in a circle around yourself. This way, your heli never gets too far away, and you never have to fly back toward yourself. Concentrate on flying slowly at a constant distance from yourself. Periodically slow to a stop, make a 180-degree turn away from yourself, and reverse direction. By circling in both directions, you won't develop a preference for turning left or right; these are hard habits to break, so you're better off not forming them.

YOU CAN EASE INTO FORWARD FLIGHT BY FLYING IN A CIRCLE AROUND YOURSELF. THIS WAY, YOUR HELI NEVER GETS TOO FAR AWAY, AND YOU NEVER HAVE TO FLY BACK TOWARD YOURSELF.

Electric-powered helicopters come in all shapes and sizes. This one from Blade has a flybarless rotor-head design for advanced performance.



For more precise and constant control inputs, it is best to start off your helicopter flight training by using the "Stick Pincher" approach for holding the transmitter's control sticks.

After you get comfortable flying reversing circles around yourself, you can gradually flatten the circle until you're flying elongated figure-8s. As you gradually fatten the slow figure-8s, you're well on the way to mastering nose-in flight. Any time you start to get confused, just pivot away from yourself so that you're back in a nose-out hover. Learn to make it a habit to fly your way out of tough spots instead of just cutting throttle and letting the heli crash.

Pilots are divided roughly into two types: "thumb fliers" and "stick pinchers." In the helicopter world, where control inputs are precise and constant, stick pinchers are far more prevalent, and it is strongly recommended that you concentrate on pinching the sticks from the start. In the long run, you'll be glad you did. It's a cliché but any skill worth doing takes practice. You might eventually master heli flying with only one or two sessions a week, but you'll achieve proficiency more quickly if you work at it every single day, preferably two or three times a day. With a focused and organized approach, you'll master basic flight skills in no time. That's when heli flying really gets to be fun.

BOTTOM LINE

Regardless of the type of model you decide to fly, becoming a good RC pilot takes practice and you have to stay with it. In the end, the satisfaction you experience becoming an accomplished sport flier is something you'll never forget. Once you nail the basics, you'll be able to move on to bigger, better, and more advanced aircraft, each with its own particular set of requirements and training. Go ahead—be successful. ✚

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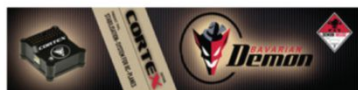
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E-FLITE/HORIZON HOBBY P-47 Razorback 1.2m BNF Basic

Scale details make this warbird come to life

TEXT & PHOTOS BY ANDREW GRIFFITH

There's something about heavy metal warbirds that gets most RC pilots' flying juices flowing, and the P-47 had an unsung yet vital impact for the Allies in World War II. The Thunderbolt was nicknamed the "Juggernaut," or "Jug," by grateful pilots for its ability not only to inflict doom on the enemy but also to absorb heavy fire and still bring its aircrew home safely. E-flite has introduced a 1200mm version of the venerable P-47 Razorback that is constructed of high-density Z-Foam. The foam parts have many molded-in surface details, and plastic parts are used where required for scale details or where additional structural strength is warranted. It is available in a Plug-N-Fly version as well as Bind-N-Fly, which is the version we reviewed.



The author is ready for the P-47's maiden flight after binding it to his Spektrum DX18 Stealth.



SPECIFICATIONS

MODEL: P-47 Razorback 1.2m BNF Basic w/ AS3X

MANUFACTURER: E-flite (e-fliterc.com)

DISTRIBUTOR: Horizon Hobby (horizonhobby.com)

TYPE: Bind-N-Fly sport scale

WINGSPAN: 47.25 in.

WING AREA: 400 sq. in.

LENGTH: 42 in.

WEIGHT: 55.5 oz.

WING LOADING: 19.8 oz./sq. ft.

RADIO REQ'D: 6-channel DSM2/DSMX-compatible

PRICE: \$239.99 (PNP); \$269.99 (BNF)

GEAR USED

RADIO: Spektrum DX18G2 Stealth transmitter (spektrumrc.com); AR636A receiver; six Spektrum A330 9g servos (installed)

MOTOR: BL15 880Kv brushless motor with 40-amp speed control with integrated BEC (installed)

BATTERY: E-flite 3S 2200mAh 30C LiPo (e-fliterc.com)

PROP: 10.5x8 4-blade (included)

HIGHLIGHTS

- Quick-and-easy assembly
- Large magnetically attached canopy/hatch
- Flaps, retracts, and optional bombs, rocket pods, and drop tank
- AS3X/SAFE system tames the P-47, even in the wind

Everything needed, with the exception of a DSM2/DSMX transmitter and a LiPo battery, are included in the BNF Basic version. Retractable landing gear, flaps, all the servos, linkages, and servo extensions are included and, for the most part, come factory installed. The P-47 comes with a factory-installed AS3X receiver with optional SAFE Technology. The required flight battery is a 3S 2200mAh 30C battery, which is a common battery for pilots who favor aircraft of this size.

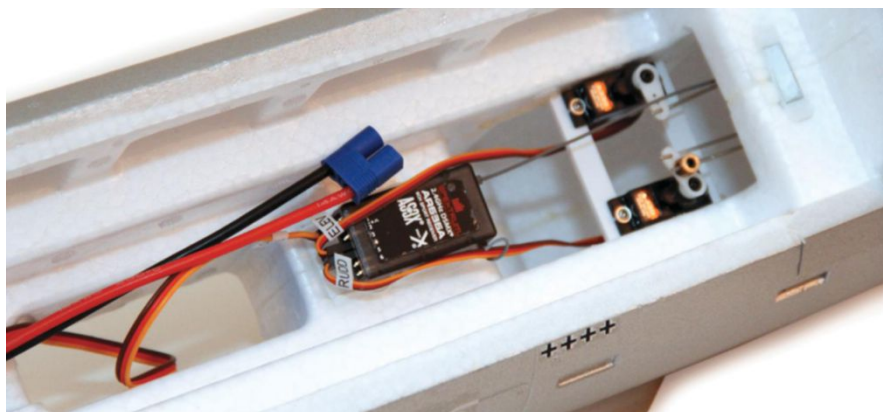
While a P-47 would normally be for an intermediate to advanced pilot, the light wing loading and built-in SAFE Technology should allow the Razorback to be successfully flown by nearly anyone who is comfortable flying a tail-dragger.

UNIQUE FEATURES

The E-flite P-47 includes both operational flaps as well as retractable main landing gear. This is functionality that most warbird pilots practically demand, and both are included without the need to buy any additional parts. All of the servos are installed, the linkages assembled, and the surfaces hinged at the factory. Everything is painted, and all the scale decals are reapplied. The result is a very nice matte finish.

A quick inspection of the exterior shows an amazing amount of detail for a relatively small foam plane. Panel lines and access panels are molded into the fuselage and wings. A cockpit with instrument panel and pilot bust are included. Small details have been well attended to on the Razorback. There are vent holes in the canopy to keep it from fogging in the sun. Also, an area that quickly looks shabby on foam planes is where the battery hatches are grasped to provide interior access; this is addressed on the P-47 by the inclusion of plastic reinforcement plates on both the hatch and the side of the fuselage so that even changing the battery for more than 10 review flights didn't induce any visible wear in that area.

Up front, there is a powerful 15-size 880Kv brushless motor that's swinging a neat-looking 4-blade scale propeller. Power is provided by an E-flite 40-amp speed control equipped with an EC3 battery connector. If you purchase the recommended E-flite battery, it also comes with an EC3 connector, so you won't even need to heat up a soldering iron. I connected my E-flite wattmeter and observed that, at full throttle and a fresh pack, the installed power system was drawing 43 amps and producing 478 watts. With a flying weight of 55 ounces, that works out to a respectable power-loading figure of 140 watts per pound. The multilingual instruction manual is both comprehensive and well illustrated. A complete spare-parts breakdown is included as well as programming information for all the current Spektrum radio systems.



Above: The Spektrum AS3X receiver and digital servos come installed.

Below: The stabilizer is reinforced with a carbon joining rod, and the molded square pin and socket ensure perfect snap-in alignment of the elevator halves.



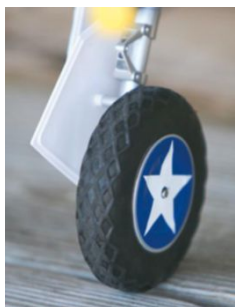
FLAPS: 10 Dos and Don'ts

DO

- Learn how your plane reacts to flaps at a safe altitude before attempting the first landing.
- Reduce the throttle to about 1/3, and let the plane slow before dropping the flaps.
- Use only partial flaps if used for takeoff.
- Adjust the power to maintain the approach path. Flaps add drag and require more power.
- Add power on a go-around, and begin a climbout before retracting flaps.

DON'T

- Deploy flaps at high speed. The flaps might depart the wings or cause serious structural or servo damage.
- Use flaps on the first takeoff and test flight. You must first determine how much deflection is correct for your model.
- Use full flaps on takeoff. This adds a lot of drag.
- Let the plane balloon and lose its airspeed. Adjust the elevator to keep the proper approach path.
- Retract flaps when low and slow or else you could settle onto the runway.



Above: Removable ordnance includes bombs, rocket launchers, and a centerline fuel tank. Left: Check out the scale treads on the tires! Below: The P-47 has plastic reinforcement on both the fuselage and the canopy/hatch to prevent damage to the foam parts.



THE BNF P-47 RAZORBACK IS A JOY TO FLY. THE PLANE WOULD MAKE A WONDERFUL TRANSITION TO HIGHER-PERFORMANCE WARBIRDS.

The P-47 comes equipped with an AS3X three-axis stabilized receiver. As an option, you can enable SAFE Technology during binding. SAFE gives you a switch that allows a self-leveling Beginner mode, a bank-limiting Intermediate mode, or an Expert mode with no limits. Either way, the AS3X is working in the background to stabilize unwanted movement from wind gusts, allowing the P-47 to remain airborne long after similar-size planes are being packed away due to wind.

IN THE AIR

I do most of my flying at our club field, and we are spoiled with paved taxiways and runways. The Razorback displays excellent ground handling on paved surfaces. I also taxied and flew the Razorback on our grass infield, and it handles well-mowed grass with very little tendency to nose over.

To take off straight, the P-47 (despite being equipped with a gyro) needs just a little up-elevator to keep pressure on the tailwheel and some right rudder until the tail surfaces become effective. Takeoff, even without flaps, is accomplished in less than 50 feet.

The flaps are effective, and the large frontal area of the P-47 coupled with the flaps and optional ordnance and drop tank combine to create a lot of drag. It slows down well with the

flaps deployed but requires almost 1/3 throttle to overcome the extra drag.

GENERAL FLIGHT PERFORMANCE

Stability: Owing to the great design of the full-scale Jug, most models of the P-47 fly well, and the E-flite Razorback is no exception. With or without AS3X, the P-47 is a stable model, and the AS3X keeps the fun going even in moderate wind.

Tracking: The P-47 tracks well in all flight regimes including clean, with ordnance installed, and with the gear and flaps deployed or retracted.

Aerobatics: While aerobatics aren't its genre, the P-47 is spirited and fun to fly. Large loops, victory rolls, Immelmann turns, and split-S maneuvers are all within its repertoire. In high rate, the roll rate is very good and stops are crisp. Inverted passes are accomplished with just a bit of down-elevator.

Glide and stall performance: The P-47 has a large frontal area and a lot of drag, so it doesn't glide well and requires some power during landing approach. That said, stalls are extremely gentle due to the light wing loading; the P-47 merely drops its nose and resumes flying as soon as the elevator is relaxed or throttle is added.

PILOT DEBRIEFING

The BNF P-47 Razorback is a joy to fly, and

other than pilots needing to learn some technique to take off straight, the plane would make a wonderful transition to higher-performance warbirds. Learning how to integrate the use of flaps and retracts as well as the proper use of the throttle to land with power could all be accomplished on this model.

The Razorback includes a lot of scale details, such as proper landing-gear doors and knurled tread on the tires. The wing-mounted rocket launchers, bombs, and centerline drop tank are a snap fit and can easily be installed to re-create missions. With the extra parts removed, the P-47 not only sports a clean look but also is noticeably faster.

BOTTOM LINE

The P-47 requires only some quick-and-easy final assembly. There are only six screws, three parts to glue, and a prop to mount. The only deviation I made was to install the Y-harnesses and feed them out the bottom of the fuselage, making it easier to make all the connections. You then pull the wires up into the fuselage and install the wing. I used 15-minute Z-Poxy to attach the Pitot tube and .50-caliber guns to the wings. The ordnance and tanks snap into place and, other than some simple programming and binding the radio, you're done. ✚

18 TOP TRAINERS

OUR PLANE, DRONE, AND HELI PICKS MAKE LEARNING TO FLY EASY

BY THE **MODEL AIRPLANE NEWS CREW**

Learning to fly is exciting, challenging, and—most of all—a lot of fun. It's best to start with a plane, drone, or helicopter that's designed to fly well and handle the demands of flight training. These 18 aircraft are models we've reviewed, and all get two thumbs up for ease of assembly and flight characteristics that will help you quickly earn your wings.

AIRPLANES



Dromida Voyager

The new micro RC Voyager from Dromida is an excellent miniature version of the full-size aircraft, and this molded-foam model comes out of the box 100 percent ready to fly. With its attractive paint scheme and molded-in details, the Voyager is a great way to break the old Piper Cub habit while maintaining easy, beginner-friendly flight performance. Small enough to transport anywhere fully assembled, it has a wing that's attached with magnets. The Voyager comes with a Dromida 4-channel Q410 2.4GHz transmitter, complete with four AA batteries to power the radio and a 1S 150mAh LiPo flight battery. For a 3-channel airplane (without ailerons), the Voyager has enough power for lively performance. You can loop with ease, and the model has good vertical climb performance. Tight high-banked circles are fun, and with a little practice, you can coax a decent wingover out of this micro flier with ease. Outdoors, after a bit of a dive to build up some speed, you can also do a nice barrel roll and even a bit of inverted flight, with forward-elevator stick pushed in.

\$89.99 | dromida.com



FMS Red Dragonfly

Molded out of durable, easy-to-repair foam, the new Red Dragonfly from FMS is an ideal configuration for anyone looking to try RC flying for the first time. It is a pusher-propeller design, with the motor located behind the wing, and it comes with landing gear to help absorb the bumps of first-timer landings. The pusher design is also an excellent choice for safety when it comes to hand launching the model from less-than-perfect flying areas, like a schoolyard or a park. Add good looks and performance and you have a winner. It is available as plug and play (PNP), ready for you to add a receiver and radio, and as ready to fly (RTF)—the version I tested. This rugged pusher design has a 35.5-inch span, and it is perfect for beginner RC pilots. Easy to assemble, the motor is located behind the wing, so there's less chance of damage during a hard landing. It comes with everything you need to get into the air, including a 2.4GHz radio system, four servos, a motor, and a 12-amp speed control all installed. A 2S 7.4V flight pack and a 12V charger are also included.

\$99.99 (PNP); \$129.99 (RTF) | forcerc.com



Multiplex FunCub XL

Made out of Elapor foam, this sturdy 67-inch-span model comes with all the molded parts needed to complete it and is available in kit and receiver-ready versions. Our kit version was easy to assemble in a few days in the workshop. Either way, you'll need a 7-channel radio and receiver. Powered by a 6S 4000mAh flight pack, the FunCub XL has nearly unlimited vertical climb performance. Its aerobatic performance can go from mild to wild, depending on how you set up the control throws. We felt that the XL is very pilot-friendly on medium rates. With the throws cranked up to the max, roll rates are quick and pitch changes are fast. This model would make a great first-competition fun-fly airplane. With its flaps, it also offers fun short-field performance, and we really enjoyed spot landings and touch-and-gos.

\$199.99 (kit); \$399.99 (receiver-ready) |
hitecrd.com

Great Planes Avistar Elite

If you're looking for a traditional glow-powered, built-up trainer, this is your answer! We love this trainer because it is a great value, it has excellent performance and stability, and there's no gluing of parts required. It comes complete with prebuilt wing, tail surfaces, and fuselage parts all factory covered with MonoKote. It includes an O.S. .46AXII AB engine with muffler and a Tactic TTX600 6-channel 2.4GHz radio system (with four standard servos and receiver, all factory installed). Also included are eight AA transmitter batteries, a spinner and propeller, and an instruction manual. (Glow fuel, fuel pump, and glow driver are required.)

\$399.99 | greatplanes.com



HobbyKing Bushmaster

The new flap-equipped Bushmaster sport model from HobbyKing is a fun airplane that will appeal to all levels of RC modelers. For the newcomer looking for a rugged second plane that's a tail-dragger to the more advanced pilot wanting flaps and excellent short-field performance, the Bushmaster delivers. If you're looking for a combination standoff Cub and a conventional EAA homebuilt aircraft, the Bushmaster is a great fun-fly machine. The plane is a basic plug-and-fly ARF, meaning that all you need is a transmitter and a receiver. The servos, motor, and speed control come installed. The fully molded EPO airframe takes only minutes to assemble. It is a true bolt-together type of plane, and there is no glue required at all. In general, the Bushmaster is well balanced and has excellent stability, with nice response at all flight speeds. The wing's slight amount of dihedral provides enough "think time" to be a good model to train new pilots.

\$160.00 | hobbyking.com



Ares Crusader II

With an appealing retro look, this 54-inch-span EPO foam model is sturdy and offers great stable flight performance. The radio gear and power system come installed, so you only need to glue the tail surfaces into place and assemble the wing panels. In the air, the Crusader II is perfectly designed to take new RC pilots from their first unsure hops and training flight all the way to basic sport flying and aerobatics. Its sturdy trike landing gear and large wheels make takeoffs and landings easy from grass fields. In the air, the Crusader II has a good tail moment, and its control surfaces provide positive tracking straight and level as well as in turns. It also has a good power-to-weight ratio, so it can easily perform loops, rolls, and even inverted flight. Included with the model are a 6-channel 2.4GHz transmitter with digital trims and a 2200mAh LiPo flight battery.

\$274.00 and up | ares-rc.com; firelandsgroup.com



Flyzone INUM Elite

This compact aircraft can be flown indoors and outdoors if the wind is calm. It comes with everything needed to fly and can be assembled in seconds. No tools are required, and it even comes with four AA cells for the included transmitter. Assembly involves sliding the wire landing gear into a mount on the front of the airplane, then you install the wing onto the fuselage by snapping the fixtures on the bottom of the wing into receptacles on the top of the fuselage. Presto! You're ready to fly—once the flight battery completes its charge from the transmitter (about 40 minutes for a full charge). In the air, the INUM Elite is definitely stable and would be a good plane for a beginner. Tracking is what you'd expect for a 1-ounce model. It does fine if trimmed under no-wind conditions or if flown indoors, but gusts of wind can make her abruptly change direction. It has a surprising amount of power. We found that, at full throttle, there was enough airspeed to do a loop from level flight, so it's plenty of fun for more experienced pilots. Beginners should strive to fly with reduced throttle settings as much as possible (except for takeoff and climbing, of course).

\$59.99 | flyzoneplanes.com



HobbyZone Sportsman S+

This plane lands by itself! In fact, with its SAFE Plus Technology, all phases of flight—from takeoff to landing—become worry-free to bolster the novice pilot's confidence. What sets this model apart is the innovative technology offered by the installed Spektrum GPS module, which provides the pilot with attitude and positional guidance. This means that the Sportsman will not fly off into the blue or get into an orientation that's difficult to recover from. And if you need time to sort things out, press the holding-pattern button and the Sportsman will circle overhead. The brushless motor, speed control, servos, and all the electronics are installed for you. Only some minor assembly is required, which we completed before the flight battery finished charging. In the air, it is inherently stable, and its ASSX three-axis stabilization gives the plane a much bigger feel. In the Beginner mode, releasing the sticks returns the plane to straight and level flight. When you are comfortable flying the plane in the Experienced mode, it is time to try some basic aerobatics. In the Experienced mode, the plane is agile and has enough power to perform loops, rolls, and stall turns. If you're a beginner pilot who doesn't have access to an instructor or who just needs the added peace of mind offered by the SAFE Plus Technology, the Sportsman S+ is the ideal plane to earn your wings.

\$219.99 (BNF); \$259.99 (RTF) | horizonhobby.com

RACING DRONES



Blade Mach 25 and Teleporter Headset Bundle

Blade's first venture into the world of FPV racing, the Mach 25 FPV Racer looks as if it means business. Easy to fly and enjoyable for everyone, this multirotor comes out of the box completely assembled and ready to bind with your Spektrum radio. There is just enough room to get the bind plug into the controller to perform the binding operation without having to remove anything. The battery is mounted in a recess located on the underside of the body using Velcro fastener material. The small 25mW micro FPV camera system includes a video transmitter, and it works rather well when flying alone. The Lexan frame does move around a bit while flying, but overall, the setup works quite well. And because of the canted motor mounts, landings are a bit easier. To get started, you will want to get at least 2 to 3 feet high right away before testing things out. The Mach 25's stabilization is very good, and it wants to get up to speed right away. It can quickly get moving if you are not careful. Control response is really good in the High-Bank-Angle mode, and you could easily race in this mode. But if you're looking for really quick and snappy flying, then the Agility mode is what you want. You'll have a blast scooting around the field. Throw in a few obstacles and another racer and you will be totally hooked on FPV racing.

\$349.99 | bladehelis.com



RISE Vusion

Your first time drone racing can be challenging, to say the least, but it is also addictive. The wise folks at RISE have a menu of racing offerings, and the Vusion is their newest entry. It includes everything you need to join the racing craze. A high-grade injection-molded plastic is used for construction, and there are LED lights on the arms. The arms themselves are quickly and easily replaceable, and if you know anything about racing quads, that feature is extremely welcome. The power system is quite adequate with 2280Kv outrunners paired with OneShot ESCs. A 3-cell 1500 LiPo flight pack also arrived in Vusion's box of goodies, and it even has a mating plug soldered on. There is also a balance charger thrown in with an AC adapter, a spare set of propellers, and four AA batteries for the radio. Another included feature worth a shout-out is the lost-aircraft locator, which will beep in the event of a crash or out-of-sight landing. A short and simple calibration process has the Vusion up and flying within a minute. The guidance transmitter has dual rates, which allows for more stability or agility as well as a switch for flight modes. Mode 1 is the most stable, features self-leveling, and allows the aircraft to tilt up to approximately 30 degrees. Mode 2 also has the auto-level attribute but now permits up to a 45-degree tilt. Mode 3 disables the self-level feature and lets the model fly at any angle and perform aerobatics. All modes feel solid, and this tells the pilot that the model is tuned quite well from the factory. The hobby/sport of drone racing is exciting and challenging. Acquiring all of the equipment that plays nicely together can be a chore in itself but not with this setup, which is basically plug and play.

\$350.00 | explore-rise.com



Hitec QuadRacer 280

This little drone is designed for the new pilot who wants to get into FPV drone racing but doesn't want to spend a lot of time on construction. Out of the box, this is a very stable flying bird, which is easy for any pilot to control. It comes with everything you need to get into the air quickly. The first thing to do right out of the gate is to start charging the included 3S 2000mAh battery, along with the included 4.3-inch LCD video monitor. Then it's easy to attach the props and the video antenna. Connect the monitor and install the included AA batteries into the supplied transmitter and you're ready to race! This quad also comes with a durable clear canopy, which lets you customize your racer to suit your personal style. The two stabilizing modes make this a very easy quad to start your racing career with. Add to that the stable, solid flight performance and you have a quad that is easy to grow with as you become more proficient at the sticks. The QuadRacer 280 offers high and low rates as well as switches for mild or fast responsiveness. We like the fact that it's ready to fly and doesn't require any flight-controller programming.

\$399.99 | hitecrd.com



RISE RXD250

Made out of carbon fiber and foam, the Rise RXD250 comes assembled and ready to accept your receiver and FPV equipment. A 250-size racer, it comes completely built with just about everything to get airborne; all you need is a receiver and battery. The flight controller, motors, and speed controls are all securely mounted and ready to go. LEDs on the bottom help with orientation, and there is even a power plug for your FPV transmitter, which has been soldered in place. All the key components are surrounded by foam, plastic, or carbon fiber, so there isn't much risk of damaging anything expensive. The landing gear is strong, but it has plenty of flex, so it won't just break off; it does a nice job of protecting your battery. The RXD250 can be flown with or without FPV gear, and we were impressed by how well it performed. Taking off with the FPV gear obviously required a little more throttle, which was to be expected. Once in the air, it was pretty nimble with both setups. Even in Stability mode, it had a nice response and reacted quickly to our inputs. It's easy to toss around but still holds its line well. For a drone that is built to withstand more crashes and hits, we're impressed overall with how well this 250 handled.

\$129.99 | explore-rise.com

CAMERA DRONES



Dromida HoverShot

Not too long ago, you needed to pick and choose compatible equipment that would work properly together, but today, there are a lot of drones ready to go without any additional equipment needed. One of these is the new the HoverShot FPV 120mm camera drone from Dromida, and it really is a blast to fly. And best of all, it comes with everything you need to get this little ready-to-fly (RTF) quadcopter into the air. It comes with a built-in 720p FPV (first-person-view) camera for in-flight still pictures and video footage. The transmitter has camera control buttons for Start, Stop, and Pause functions, and after takeoff, a built-in Altitude Hold feature helps the HoverShot maintain a stable hover for good-quality aerial photography. A built-in safety feature is the Motor Start/Stop button, which must be engaged before you can fly. Whether it is set at High or Low rates, the HoverShot is extremely stable and easy to hover, even outside in slightly breezy conditions; flying indoors, it is rock solid. To get the HoverShot airborne, press the Motor Start/Stop button to activate the motors. Next, press the Auto Takeoff/Land button and the drone will lift off to about a 3-foot altitude. If you don't move the throttle stick, the built-in Altitude Hold function will try to maintain the same altitude. Overall, the new HoverShot FPV Camera Drone is a winner in both stability and the quality of the airborne photography it offers. I think anyone wanting get an easy-to-fly camera-equipped quadcopter will love it.

\$99.99 | dromida.com



Yuneec Breeze

The Breeze comes fully assembled and only requires downloading the Breeze Cam app along with a quick charge of the batteries (two are included) before getting it in the air. A solid little quad has the camera gimbal mounted on the back so that it is always facing the pilot and ready to capture photos or video selfies. Any smartphone will give you control of the Breeze through the Breeze Cam app. By using the various flight modes, you will be able to capture complex shots with little or no drone-flying experience. About the only thing easier than sharing images on social media with this quad is flying it; it is, without a doubt, one of the easiest quads to fly that we have ever reviewed. This is the perfect first drone for anyone, and the best part is that it is loaded with all kinds of great features that are usually only available with higher-priced quads. Its smart features offer a number of cool video and photo options. The Selfie mode makes it easy to position the Breeze in just the right spot for the best aerial image or video. Pilot mode gives the operator complete control over the drone, and Orbit mode puts the Breeze into an orbit around you or any external object. This is a drone that is made for everyone: It's stable, safe, and easy to fly. If you want a drone that can take good images and allow you to easily share them, the Breeze is the perfect quad for you.

\$379.00 | yuneec.com



Traxxas Aton+

This all-in-one aerial video/camera package with three solid flight modes is ideal for pilots at all levels. Because everything you need is included, this is an aircraft that you can buy and take right to your flying site! The Aton+ will arrive in Film mode for smooth, stable flight, so you can concentrate on getting the aerial shot you want. When you exit a turn or stop abruptly from lateral movement, the quad will slowly return to a hover without jerking to ensure stabilized footage. Engage Sport mode and you can now fly faster, perform higher banked turns, and do flips. You can also use the higher speed to film faster-moving subjects. In Expert mode, the Aton+ will do almost anything but fly inverted, and it's impressive when it rips by at full speed. When you fly upward a bit, hit the trick button and see the rotations the Aton can accomplish. Don't worry about pushing the aerobatic envelope too hard; the airbrakes do a great job at settling the quad back down to a hover from your high-speed antics. The included "batwing" 2.4GHz transmitter has a small digital screen, which gives you info such as flight-mode status, throttle level, transmitter-battery level, and flight-battery level. The included flight pack with the Aton+ model is a 3-cell 5000mAh LiPo. The model is equipped with a Traxxas High-Current Connector. Without a camera, you can expect up to 20-minute flights; with a GoPro HERO4 you can expect up to 15-minute flights.

\$399.99 | traxxas.com

DJI Phantom 4

As with its predecessor, the DJI Phantom 4 is mostly a hollow plastic shell, with highly optimized electronics at its core and a fully integrated camera system. It comes preassembled and, after a summary firmware update and system check, will fly right out of the box. Anybody could fly the Phantom 4 with ease, yet it is intended for intermediate to professional pilots. The basic package comes with a radio, a single battery, a charger, two sets of propellers, a 16GB micro SD memory card, and accessories. DJI also sells a premium kit with two extra batteries and a backpack. We must also mention the included lens-cap/gimbal-holder clip, which is both useful and practical, contrary to the one that came with previous iterations of the Phantom. It comes in a durable,

compact, reusable, stiff foam case with a handle and a latch that serves both as product packaging and as a practical way of carrying your drone around. It's large enough to carry the aircraft with three batteries, the radio, and a few spare propellers and accessories. You will need an Android or Apple phone or tablet to display the video (FPV) with on-screen display. **\$1,199.00 (basic) | dji.com**



HELICOPTERS



Ares Optim 80 CP

Eight inches long with an 8-inch-diameter rotor, this nano-size collective-pitch helicopter is great for beginners stepping up from coaxial and fixed-pitch designs. It's ideal for pilots who want to progress from basic hovering flight up through aerobatics and even inverted hovering! Ares' proprietary six-axis flight-stability system has the added safety of self-leveling capability (and it even works with the heli upside down!). The Optim 80 CP comes ready to fly with a 2.4GHz transmitter, two 1S 180mAh LiPo cells, a charger, extra rotor blades, and tools. Featuring an integrated three-in-one receiver, speed control, and flight-stabilizer unit, it is powered by a coreless motor.

\$149.99 | ares-rc.com



Blade Scout CX

Weighing in at a little over half an ounce, the Blade Scout CX is, in a word, "amazing." It comes with a 3-channel, 2.4GHz radio, a 1S LiPo battery, and, best of all, it is so easy to fly, anyone can be successful with it, even if you have never held an RC transmitter before. In no time at all, you'll be able to hover it and guide it around in the smallest of flight areas, like your kitchen or dining room. The Scout CX is very lightweight but rugged enough to take a few knocks. The body is held on with some alignment pins, and really, there's no reason to take the body off. Two main rotor blades and the battery pack are located between the landing skids, making them easy to install and remove. A single circuit board does all the thinking and makes the Scout CX extremely pilot friendly. Just in case you do manage to bend something out of shape, replacement parts are available to keep your Scout CX flying like new.

\$49.99 | bladeheli.com ✚

GREAT PLANES Zero

Not just a sport flier, this plane's a sport fighter

BY MICHAEL YORK PHOTOS BY JENNY & MICHAEL YORK

So you've built and flown a trainer or two and are ready to move up to a sport flier, but you want something that doesn't look like the rest of the sport-plane lineup? Well, I present to you the Great Planes Zero. Part of its Sport Fighter series, this all-wood ARF model can be powered via electric or glow, and it definitely doesn't look like your run-of-the-mill sport flier.



SPECIFICATIONS

MODEL: Zero Sport Fighter Series ARF

MANUFACTURER: Great Planes (greatplanes.com)

TYPE: Sport scale ARF

WINGSPAN: 56.5 in.

WING AREA: 537 sq. in.

LENGTH: 46 in.

WEIGHT: 4.8 lb.

WING LOADING: 20.6 oz./sq. ft.

RADIO REQ'D: 4- to 5-channel

POWER REQ'D: RimFire .32, .46-.55 two-stroke, or .70 four-stroke

PRICE: \$149.99

GEAR USED

RADIO: Tactic TTX650 transmitter w/ TR624 receiver and TSX25 servos (tacticrc.com)

MOTOR: Electrify RimFire .32 brushless motor (electrify.com), Castle Creations Edge Lite 75 speed control (castlecreations.com)

BATTERY: FlightPower 4S 3300mAh 25C LiPo (flightpower.com)

PROP: APC 13x8 Thin E (apcprop.com)

HIGHLIGHTS

- Easy and quick building
- Doesn't look like your typical sport plane
- Wide flight envelope
- Hardware for either electric or glow power



This gives you a good sense of the manageable size of this plane. It easily fits fully assembled in the back of a midsize SUV. As soon as you unload, you can get flying.

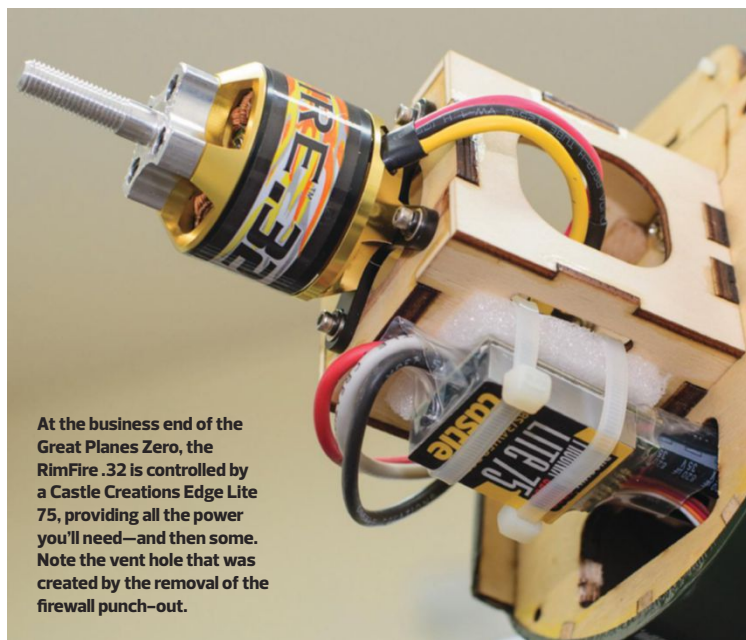
Although it has the appearance of a fighter, it doesn't have complexities such as flaps or retracts normally associated with a warbird, which makes it a perfect transition model for the advancing novice.

The Zero's airframe is comprised of light ply/balsa covered in heat-shrink film, a lightweight but sturdy fiberglass cowl that covers the powerplant, and a vacuum-formed canopy that acts as an access hatch. A full hardware pack includes the fixed landing gear, plastic spinner, mounts for either electric or glow power, a preplumbed fuel tank, and hook-and-loop

fastener material to hold your energy source of choice. You supply the radio gear and either a .46- to .55-size two-stroke or .70 four-stroke glow engine—or (as I did) a RimFire .32 brushless motor, Castle Edge Lite 75 speed control, and a FlightPower 4S 3300mAh LiPo battery.

Very thorough instructions make this a great plane for novices who want to do more assembly, and the Zero's flying characteristics will make sure that you continue to enjoy the plane as you progress to more advanced flying.





At the business end of the Great Planes Zero, the RimFire .32 is controlled by a Castle Creations Edge Lite 75, providing all the power you'll need—and then some. Note the vent hole that was created by the removal of the firewall punch-out.



There's plenty of room for gear here. The long battery tray allows the use of various battery sizes and center-of-gravity fine-tuning. If you decide to go glow power, a preplumbed fuel tank is included as well as a laser-cut throttle servo tray.

UNIQUE FEATURES

The 56.5-inch-span wing comes in two pieces that are joined with 30-minute epoxy using a laminated-ply dihedral brace. An alignment pin at the rear of the wing ensures that everything lines up nicely without any fuss. Filling the void on the fuselage underside is a painted vacuum-formed belly pan that has a nearly perfect fit. The tail feathers slide into place after removing a small spacer at the rear of the fuselage and square up with the wing without any adjustment needed.

All the control surfaces are preglued and require only a security tug before installing the control horns. In the wing, the servo bays are cut to fit perfectly the recommended Tactic TSX25 mini digital servos. If you go with a different servo, it is just a matter of trimming the opening to fit.

Both electric and glow powerplant mounts are included. The electric mount needs to be glued together, but alignment tabs allow it to be

built straight and true while you hold it in your hands. Mounting-bolt locations are marked on the firewall, but because they are not predrilled, it gives you the flexibility to modify the location if you decide to use a nonstandard powerplant. Knockout panels provide airflow to cool the battery in the fuselage. If you go glow, leave these in place and coat the firewall with thinned epoxy or fuelproof paint.

The large canopy/access hatch comes with a knockout panel on the cockpit base, which allows you to easily add a pilot. Simply remove the panel, install the pilot on that panel, then glue the combo back into place with a few reinforcement strips.

Because this is a sport fighter, the main landing gear is fixed in place, but it does include gear doors to give it a bit more flair.

As with most film-covered ARFs, a little reshinking was needed. A nice touch was that all of the sealed panels had small pinpricks to allow air to escape while heat was applied,

preventing the covering from ballooning. Be careful with the green portion as too much heat can discolor it.

Completing the Zero look is a set of precut pressure-sensitive decals. Because these have a large surface area that can trap air bubbles, I applied them using the window-cleaner method: Spray the mounting surface with window cleaner, apply the decal and adjust its position, squeegee out any cleaner and bubbles, and let it dry.

IN THE AIR

As always, I do a preflight balance and weight check. To my surprise, the Zero actually came in under the advertised weight. With the recommended battery at the forward position, the center of gravity (CG) was just ahead of the midpoint of the recommended range; if you want a more-forward CG, you'll have to add weight. I found this location just about perfect.

Test-flight day was a bit breezy but right

Certainly not your typical sport plane outline! The Zero Sport Fighter combines that perfect balance of fighter looks with easy and fun flight characteristics. It's a great plane for both intermediate novices and experts.



down the runway. As I started to add power for takeoff, the tail lifted almost immediately with good control authority, and before I was past quarter throttle, the Zero was already airborne. Obviously, there is enough power. My climb to the usual three-mistakes-high trim altitude was quick, and once there, the Zero only needed two clicks of down to stay level at half throttle.

I was impressed with how this plane handled the gusty winds, and I had no qualms performing low-level passes for the camera under these conditions.

Thanks to the wind, the landing approaches were nice and slow over the ground. Just a little power gave the plane an easily controlled descent, followed by a planted feel once on the ground.

GENERAL FLIGHT PERFORMANCE

Stability: As expected, the Zero handles like a sport plane should: It has some positive stability

Despite the light wing loading, the plane did a great job handling the day's gusty conditions. Just a couple of clicks of power let the Zero penetrate the wind nicely during the landing approach, with positive control to touchdown.



ON LOW RATES AND POWER SETTINGS, IT IS A DOCILE FLIER BUT DISPLAYS ITS SPORTY SIDE WHEN THINGS ARE TURNED UP.



Low-Stick Paper Tape to the Rescue

When building planes, whether kits or ARFs, you often need to measure and draw out centerlines to aid in drilling locations. Often this is done on soft balsa, and even the lightest touch with a felt-tip marker can leave a permanent indentation mark. The other issue might be that even a dry-erase marker can leave behind some residue (especially on nonglossy surfaces).

You could use masking tape as a protector and marking surface, but even the blue painter's tape can sometimes be difficult to remove without leaving a dig mark in the balsa or lifting the covering from solid surfaces.

Many years ago, I discovered Safe-Release masking tape, a very-low-tack paper tape by Scotch brand. It is basically the sticky-back portion of a Post-it Note on a roll. It is thick enough to prevent a marker tip from denting the surface below, is sticky enough to stay in place on just about any surface, yet removes very easily without any residue. I used it on this particular build to square up the control horns to the servo pushrods and to make sure that the landing-gear strap holes were located at the recommended distance from center.

Give it a try on your next build. You'll wonder how you did without it.

but not so much that you can't have fun with it.

Tracking: With the CG near the midpoint of the range, the plane stayed right on course. It never exhibited any traits of snapping out of even the tightest turns.

Aerobatics: The control surfaces don't lend themselves to 3D, but at full throw, it will basically do whatever you want. Rolls are crisp, and there is surprisingly little coupling when on knife-edge.

Glide and stall performance: Because it is relatively light and has quite a bit of drag, it won't be winning any gliding contests. Stalls need to be forced, and recovery is very quick.

PILOT DEBRIEFING

In the air, the silhouette of the Zero is unmistakable; it's definitely not your typical sport plane. On low rates and power settings, it is a docile flier but displays its sporty side when things are turned up.

So let's see: Easy to build—check. Flying fun for novice and expert alike—check. Stands out in the air and on the flightline—check. It looks as if Great Planes hit all the marks with its Zero Sport Fighter!

BOTTOM LINE

A couple of evenings is all it takes for even a novice builder to get this plane from box to flightline (and much of that time is waiting for the epoxy to cure). True to sport-plane fashion, you'll be spending your time flying rather than worrying about complex airframe mechanics or radio programming. But unlike typical sport planes, you'll be doing it in the guise of a World War II fighter. This sport ARF will appeal to a wide range of pilots. ✚

HOW TO

Add a Curved Checkerboard Scheme

UPDATE YOUR ARF WITH A NEW LOOK

BY JOHN REID

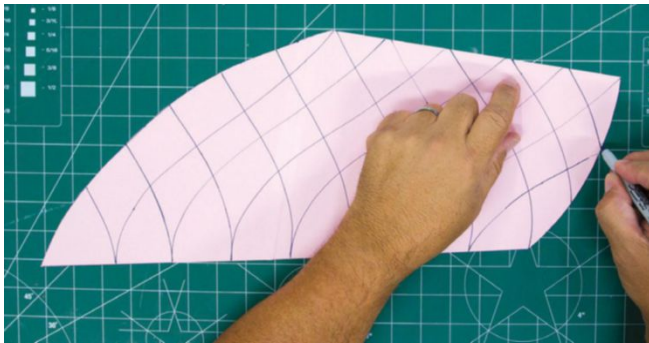
This month, we are going to show you how to add a checkerboard design to an already-existing color scheme. I used the E-flite Shoestring and UltraCote covering. Because we are using heat-shrink covering, this technique can be applied to any balsa-covered ARF that you have. This is especially useful for club events, such as fun-flys, Club 40 pylon racing, or (in this case) NMPRA (National Miniature Pylon Racing Association) EF1 racing, where this plane is required for a contest.

Here is the finished Shoestring, with the new orange checkerboard design in place. This quick addition to my Shoestring will allow me to easily pick it out when I am racing.



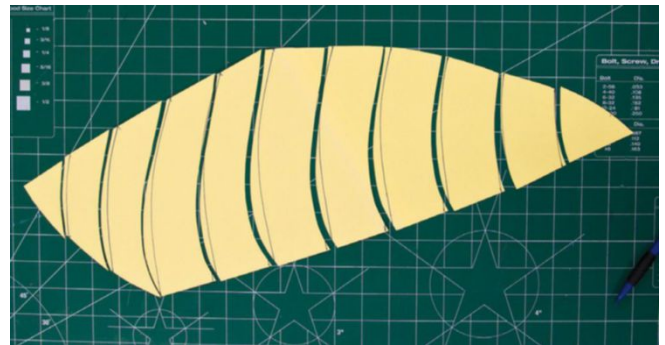
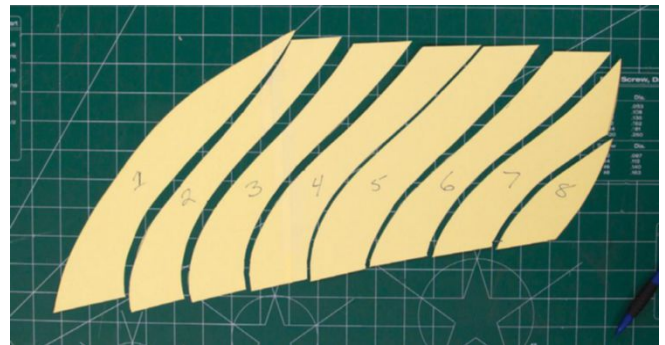
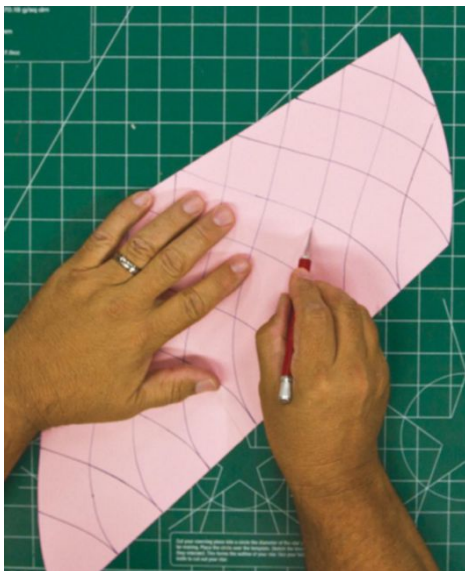


1 I started by making a template of the area that I wanted to enhance. In this case, I wanted to fill in the yellow area on the wing with an orange checkerboard. My templates were cut out of cardstock, and once I made my master template, I copied this onto two other templates and cut them out.



2 I took one of the templates and created a new checkerboard design on it. In this case, I followed the left-hand curve by using one of the other templates and moved it over roughly 1 1/2 inches to the right each time. I then used the right curved part of the template and started on the right side, moving it the same way in the opposite direction, which creates the checkerboard design.

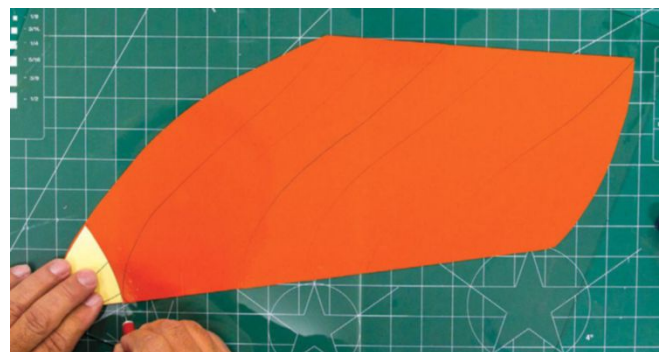
3 I used the template with the checkerboard design on it, and I followed all the lines going in one direction with a no. 11 hobby blade. This made strips so that I could transfer onto one of the other blank templates. After transferring that set of rows onto the second template, I taped up the first template (the one with the checkerboard design) with clear tape so that I could then cut all of the other lines to create a second set of rows going in the opposite direction.



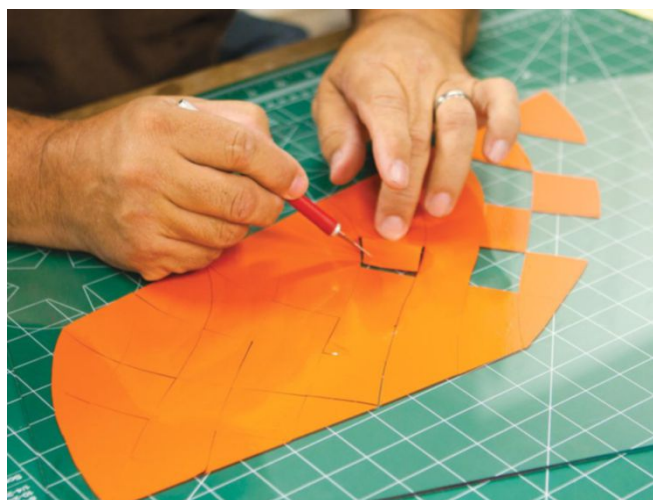
4 The second template will have all the rows in this direction, which will end up being the first cuts onto the orange UltraCote. Write the numbers on the pattern pieces to keep them organized. The third template will have all the rows in the opposite direction so that, when they are combined onto the orange UltraCote, they will form a checkerboard design.



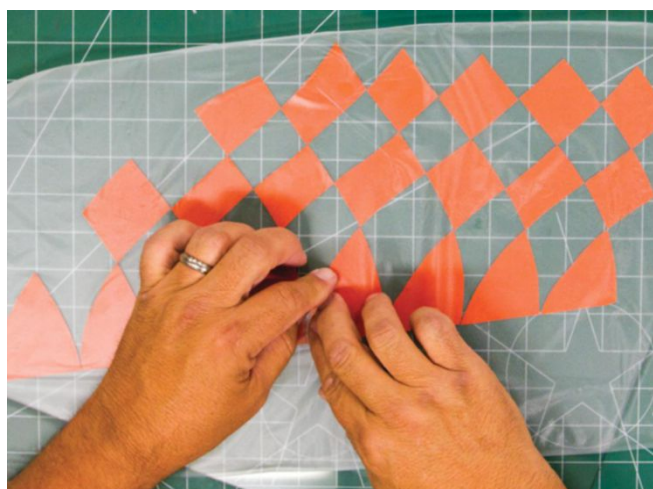
5 I laid down a piece of glass that was large enough for the UltraCote piece that is needed to cover the design. I sprayed the glass with some window cleaner and then removed the backing off the covering and laid it down onto the wet piece of glass. I rubbed out all the air bubbles from underneath the UltraCote so that it stuck firmly to the piece of glass.



6 Using the second template, I cut out all the rows going in one direction on the covering material, which you can see is already done in the photo. I then used the third template to cut out all the rows going in the opposite direction. This formed the checkerboard pattern.



7 After all the cuts had been made, I started pulling out the opposite diamonds to form my checkerboard pattern. I made sure to hold down all the squares that surrounded the one I was pulling out to ensure that I had complete cuts through the UltraCote. I did not want to pull up any extra squares that shouldn't have come up.



8 I then pulled off a piece of multipurpose sealing wrap to lay down over the checkerboard. I pressed down on all the triangles so that they stuck to the sealing wrap. This allowed me to pull them up off the glass without disrupting the design.



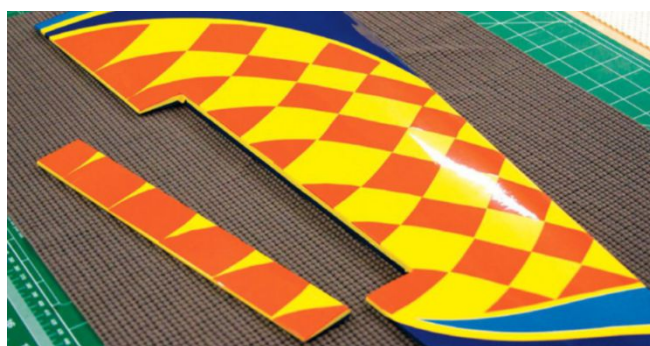
9 I then laid the checkerboard pattern design down on the wing and centered the whole thing.



10 I set my heating iron to one of its lowest settings and lightly pressed it on each of the orange UltraCote triangles to stick it in place on the wing.

11 I then adjusted my heating iron to a higher setting, which allowed the pieces of the UltraCote covering to stick down firmly without shrinking them. After slowly peeling back the sealing wrap, I applied the heat iron to each of the orange checkerboard diamonds.

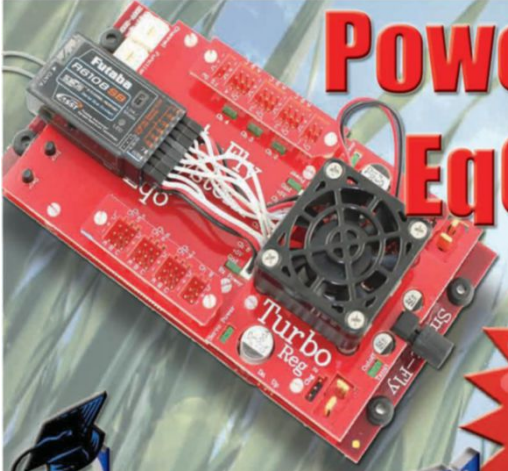
Be sure to remove the sealing wrap slowly to avoid pulling up any of the checkerboard diamonds. When the sealing wrap was removed, I went back over the entire checkerboard with the iron to get a firm adhesion.



12 Here, I followed the line of the aileron and cut through all the checkerboard diamonds that spanned over the opening. I then sealed down the excess covering for a clean finish on that control surface.



13 To finish off the design, I used 1/8-inch trim tape around the outside of the checkerboard to give it a clean and polished look. ✈



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Convergence

**An amazing crossover aircraft that is both
a multirotor and a plane**

BY JOHN REID PHOTOS BY CHERYL VOMACKA MALTBY





The Convergence in forward flight (above) and in hover (below). Notice how the rear fan is off when not needed in forward flight.



When something new and different comes to the marketplace, you can almost be certain Horizon has something to do with it. Their new E-flite Convergence VTOL (vertical takeoff and landing) is just such an aircraft: an easy-to-fly wing that can take off and land vertically. This durable Z-Foam plane is well constructed and will take the abuse of many flights. We tested the BNF (bind-and-fly) version, which is the perfect setup for the pilot who wants everything ready to go.

Everything is installed, and you just need a 6+ channel DSMX transmitter to bind to the aircraft. After that, just install a charged 3S 2200-3000mAh battery pack and you are off to the flying field. This plane should be flown by a pilot who knows how to fly a fast sport plane and has had some time with hovering helicopters or multirotors. With these two skills under your belt, you will have no problem flying the Convergence. I found this bird easy to adapt to, and I was flying comfortably within the first few minutes of flight. The sleek, delta-wing design gives this plane its nice looks, and the three brushless motors provide more than enough power to hover this aircraft with good performance. They can also really kick up the speed when the plane flies in level flight. As if VTOL wasn't enough, the Convergence can be set up to fly first-person view (FPV) as well. So, let's get to it and see what we need to do to get this plane up and running.

SPECIFICATIONS

MODEL: Convergence VTOL

MANUFACTURER: E-flite [e-flite.com]

DISTRIBUTOR: Horizon Hobby (horizonhobby.com)

TYPE: Delta wing/multirotor

WINGSPAN: 25.6 in.

WING AREA: 291 sq. in.

LENGTH: 26.9 in.

WEIGHT: 1.7 lb.

WING LOADING: 13.36 oz./sq. ft.

RADIO REQ'D: 6+ channel DSMX

PRICE: \$249.99

GEAR USED

RADIO: Spektrum DX18 (spektrumrc.com); receiver (installed)

MOTOR: E-flite 2210 brushless (main); E-flite 2730 brushless (tail); E-flite 20-amp speed control

BATTERY: E-flite 3S 2200mAh LiPo

PROPS: Included

HIGHLIGHTS

- Cool looks
- Can perform new aerobatic maneuvers
- Almost ready to go out of the box
- Durable construction

UNIQUE FEATURES

When you pull the Convergence out of the box, you find that all of the control surfaces are connected and the motors are mounted and connected to the appropriate servos for movement. The two tails need to be screwed on, which takes a total of two minutes. Next, you install the props, which are labeled for left and right motors. After a total of five minutes of assembly time, I was ready to start programming my transmitter, after which I bound it to the plane. Most of my time was spent on setting up the radio for this aircraft's special features. The manual has good instructions on all the programming needed, and it was just a simple matter of entering in the values that were recommended.

Because this plane transitions from hover flight to level flying, there are two different modes of flying that the pilot can use, which gives a good range of performance for each phase of the flight. Stability mode limits the pitch and bank angles and will work to keep the plane level when the sticks are released. This mode also engages during the transition when going from multirotor to airplane flight. This mode makes it easy for any pilot to fly and should be the one all pilots start with. Acro mode has no angle limits or self-leveling during any phase of the flight. This is the mode to have when you want to perform aerobatics during airplane flight. Be aware that, in this mode, you will need to stay on top of the plane at all times.

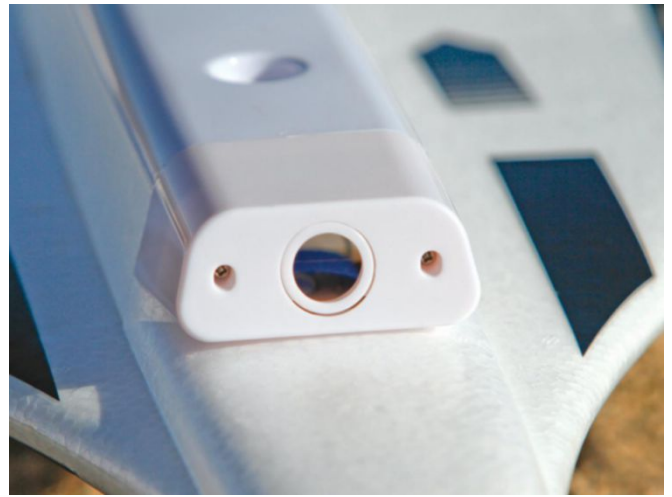
With all of the programming done, it was

time to bind the plane to the radio. I was able to check all the flight-control directions for forward flight. Once all of the elevator movements were confirmed, I placed the plane on my front lawn and hovered it a few inches off of the ground to make sure that all of the multirotor flight controls were performing in the correct directions. Everything checked out, so it was time to top off the batteries and take this bird to the park and do some test flying.

The Convergence will accommodate a number of FPV camera systems. There is a camera bay under the nose and a place to mount the video transmitter at the top rear of the aircraft. Both locations are easy to access and easy to mount the equipment to.



The rear motor is only activated during hovering flight.



The mounting blocks for the optional FPV gear are installed and ready for your FPV camera.



The motor tilt is activated by a servo mounted in the motor nacelles.

The one and only Mike McConville tests out this very cool aircraft.



BEHIND THE SCENES

Creating the Convergence

We got a chance to talk with Convergence designer Mike McConville about the process of coming up with such a unique aircraft. Mike offers up some behind-the-scenes information on what it takes to design something as special as the Convergence.

Model Airplane News: *Was there a reason to use the flying-wing design for this type of aircraft? Did it add to the stability?*

Mike McConville: Yes, a few reasons. It is better for stability. A good delta-wing configuration has no tip stall, so it made for the most stable airplane platform. We also wanted a cool, futuristic jet look that worked well with the delta wing.

MAN: *Did you have to adapt the programming for the transition from hovering to forward flight? Or did this require a completely new programming code from what you already had for drones and planes?*

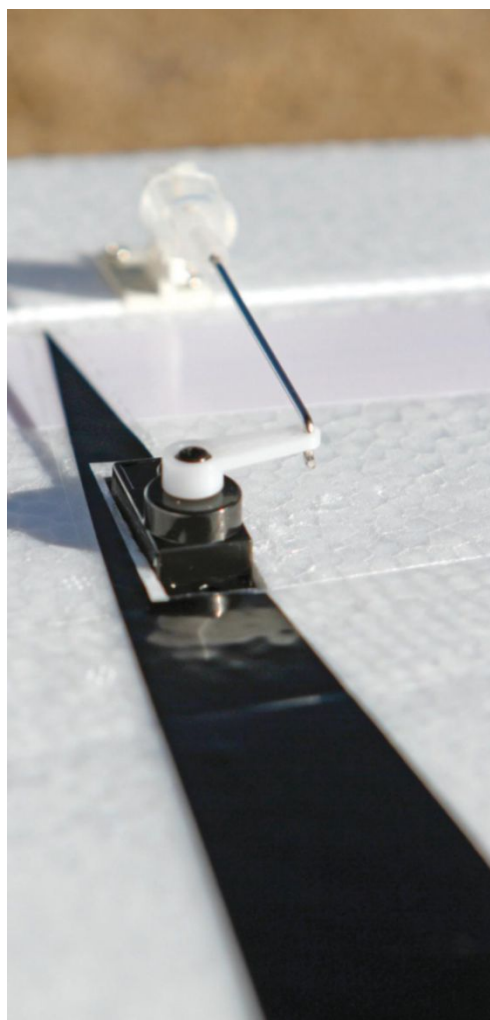
MM: Transition to and from forward flight was, by far, the biggest challenge. This required many hours of testing and changing to arrive at the final solution. There really was no code for drones or planes. We had to arrive at a new solution to make the transition safe, stable, and as foolproof as possible. It was not an easy task.

MAN: *How many test designs did you have before finalizing on this design?*

MM: The basic airframe design wasn't changed much from the prototype. A few tweaks and improvements were made over a couple of prototypes. The lion's share of the work was in the creation and tuning of the flight-control logic. That's where the real magic lies, and that part took many, many iterations to get it done.

MAN: *Are there any interesting stories you would like to share about your first test flights?*

MM: The first test flight was done near the factory in China. I took off and flew in Vertical mode for the first battery with no big issues. On the second flight, I decided to attempt a transition to forward flight, so I climbed to a few hundred feet plus—just in case. When I flipped the switch, the model pointed 45 degrees nose-down and flew that line all the way into the ground...ouch! That's when I knew this was going to be a real challenge. It took about five months to go from a disaster to the final product. I'm pretty proud of the progress made and the final result.



The aileron servos have a very short linkage attached to a rather long arm. This allows for the large precise movements needed to respond quickly to stick inputs and flight adjustments.



THERE ARE TWO DIFFERENT MODES OF FLYING THAT THE PILOT CAN USE, WHICH GIVES A GOOD RANGE OF PERFORMANCE FOR EACH PHASE OF THE FLIGHT.

IN THE AIR

Because the Convergence has vertical takeoff capabilities, it will fly from paved, dirt, or grass runways. But do keep in mind that because all the props are blowing downward, dirt and grit from a grass runway will get blown into the props and motors. Really tall grass will hit the props, so make sure that your takeoff spot is flat and level. Lifting off in Stability mode is very easy, and I would recommend it until you get the hang of flying this bird. Once in the air, you can transition to forward flight and Acro mode. If you are new to flying, keep it in Stability mode for the entire flight. I found that the Convergence had better forward-flight performance in Acro mode, and this is the mode you will need if you plan to do any aerobatics. Be aware that the controls will be much more sensitive in Acro mode, so you will need to lay off the sticks when flying. The transition from plane to multirotor is just as easy; be sure to switch back to Stability mode and your touchdown will be a snap.

GENERAL FLIGHT PERFORMANCE

Stability: In Stability mode, this plane is rock solid in both flight envelopes and is easy to control and fly. Stability is a little less in Acro mode, but if you have the flying experience, it is still a very stable aircraft.

Tracking: In forward flight, the Convergence tracks very well in both flight modes; when in multirotor configuration, it tracks as well as any multirotor.

Aerobatics: Once you have command of the Convergence, you can then have some fun. You will be able to create some moves that no one has ever done or seen before!

Glide and stall performance: The glide of a delta wing is never all that great, and you will need some speed and nose-down attitude for deadstick landings.

PILOT DEBRIEFING

This is a fun plane to fly, and its hovering performance really shocked me. I was not expecting it to be so stable and easy to fly (in

Stability mode). Its top speed was not as fast as I anticipated, most likely due to the lower pitch props and motor, but it was still fast enough for some nice fast flybys. If you want a plane that is different and fun, this is the one for you.

BOTTOM LINE

The Convergence is a fun-to-fly plane that has the cool features of vertical takeoff and transition to forward flight, and the best part is that it's easy to fly. If you take some time learning how this bird flies, then, before you know it, you will be doing some very unusual aerobatics that are just not possible with other planes. If you want a unique aircraft that crosses over from plane to multirotor, this is the one to get. You will like this plane. ✈

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One of the amazing exhibits was this surround visual display from LG OLED TV. This presentation attracted a lot of spectators.



CES 2017

THE LATEST AND GREATEST ELECTRONICS, FROM GADGETS & GEAR TO DRONES

BY THE **MODEL AIRPLANE NEWS CREW**

Held in Las Vegas, Nevada, every January, CES is one of the largest trade shows around, with more than 200,000 attendees getting a first look at the latest and greatest technology. This year, unmanned aerial vehicles filled the South Hall of the Las Vegas Convention Center and ranged from selfie drones to giant-scale commercial aircraft. While we were there mainly to check out the latest in drone technology, we just couldn't help looking at all the other cool electronic products.

Attendees explore the show floor on CES opening day. While this day had some very large crowds, all of the other show days were just as packed.



NBA legend Shaquille O'Neal at the C Space Variety event at CES 2017. He's talking to David Levy, president of Turner, and Andrew Wallenstein, co-editor-in-chief of variety.com and *Variety* magazine.





Above: Smart rings are nothing new, but so far, the Motiv Fitness Ring seems like one of the more interesting ones we've seen so far. Having a ring as a fitness tracker seems fairly nonintrusive when compared to one in your pocket or on your wrist. A built-in three-axis accelerometer can track active minutes, activity intensity, sleep duration, heart rate, calories, distances, and (of course) steps.

Below: This SuperSession on the "Power of Hidden Figures" discusses the importance of diversity and the essential roles of technology in getting that information out there. The panel featured special guests from the highly anticipated Twentieth Century Fox film *Hidden Figures*, including actress Octavia Spencer.



Above: The PowerVision PowerRay is a very cool underwater drone that can be used with the PowerRay Fishfinder. The Fishfinder is detachable and can be used as a stand-alone device. Detailed information such as fish distribution, underwater temperature, depth, and fish alerts are all displayed on the mobile app. Once the fish are found, you can use the PowerRay to place the fishhook at the desired location and then it is just a matter of waiting for that nibble.

Below: With a push of a button, the PowerVision PowerEgg takes off automatically and hovers at the designated altitude. Landing is just as easy: Push the button and it lands automatically. The controller, called the Maestro, is a gesture-recognition remote control and makes it easy for anyone to fly this bird. Other features include a safe user distance, smart maximum-distance mode, and a pause function that freezes the PowerEgg in midair like an emergency brake. It's priced at \$1,288.00.



Above: A cool little foldable drone, the Mola-UFO fits into the palm of your hand, and it has a number of intelligent features. It has advanced three-axis EIS image stability to take high-quality images, even in a windy environment, and its Vision Lock with intelligent track lets it recognize and follow the subject and lock onto it. The UFO can even be programmed to recognize more than six types of gestures!

Below: Now your pet can have its own personal trainer, just like you can. The Canhe-Fit collar-mounted pendant will monitor your pet's daily activity and make nutritional recommendations based on its energy expenditure, breed, age, and weight.



RotorDrone Magazine Winners

At the 2017 CES extravaganza in Las Vegas, we were amazed by how many new and innovative drones were released at the show. As a CES Media Sponsor, our sibling publication *RotorDrone* magazine had the honor of giving out six awards to the top drone and drone-related products at CES. These aircraft and accessories are amazing!



TOP VALUE › Propel Star Wars Drones

Now you can bring the magic of flight to a whole new dimension with these *Star Wars* drones. The Speeder Bike, X-Wing Starfighter, and Advanced X1 can fly at speeds above 35mph, and they can interact with exciting multiplayer laser battles. Each hand-painted drone sells for just under \$200.00 and is extremely detailed, certified, numbered, and packed in a collectible display box. But they are not meant to stay in those display boxes; these are extremely durable quads designed to last, battle after battle. → us.propelsw.com



TOP INNOVATION › DJI CrystalSky

Yes, we know this is not a drone, but it goes hand and hand with them. This screen was created for outdoor aerial imaging and features an ultrabright screen that is clearly visible in sunlight. It is designed from the ground up to work seamlessly with the DJI GO app, giving camera operators a clear view and total control. → dji.com

BEST OF SHOW › Yuneec Typhoon H520

This new drone builds on the proven Typhoon H platform and has commercial-grade cameras and features for high-end professional use. Three new cameras will also be released for this drone: the CGO3+, an ultrastable 4K ultrahigh-definition video camera; the CGO2t, a dual-streaming camera that can record infrared and residual light in separate streams so that you can overlay them; and the CGO2c camera, which is optimized with an all-glass seven-element lens that is the equivalent of a 50mm lens—perfect for cinematic and industrial use. This bird features retractable landing gear and offers longer flight time, greater payload-lifting capabilities, and a modular design for simple camera swaps. → yuneec.com





BEST CONSUMER DRONE › Hover Camera Passport

This durable, light drone has a carbon-fiber body with a soft rubber coating. It is a foldable, self-flying personal photographer that will follow you around for a unique perspective. This \$599.00 device can spin and take 360-degree panoramic videos and orbit around you. It will also do face and body tracking. The props are all enclosed, making it safe to fly anywhere. → gethover.com



BEST COOL TECH › Wingsland S6 4K Pocket Intelligent Drone

This pocket selfie drone can take off from your hand and record 4K 30 UHD video in the air. It can be connected to your smartphone so that you can instantly share your aerial selfie videos. Priced at \$370.00, it has features like smart return, voice control, panorama mode, slow motion, time-lapse, and automatic follow-me mode. Options also include obstacle sensing and avoidance, a searchlight, a display board, and a mini cannon. → wingsland.org



BEST PROFESSIONAL DRONE › DJI Inspire 2

What can you say about the Inspire? It was a leading drone for the pro shooter, and now there is the Inspire 2. Some improvements include 25 to 27 minutes of flying time, plus this drone can support many types of cameras and fly at speeds of up to 58mph! Its all-new image-processing system records at up to 5.2K, and its revised flight autonomy provides two directions of obstacle avoidance and sensor redundancy. This is a solid drone, and it costs less than \$3,000.00. → dji.com

Eight Oddities

While CES hosts some incredible technologies, there are a few items that are, ahem, a little offbeat. Here are eight of the most unusual products we saw at this year's show.



Hushme

Sitting at the office and a private call comes in? How can you talk without your coworkers hearing what you say? One way is with the Hushme, billed as "the first voice mask for mobile phones." It is designed to let you gab without the fear of your coworkers judging what you say. No guarantees, however, that they won't judge you for looking silly.



Smart Toast

Need to get the perfect piece of toasted bread? Griffin Technology might be able to help with its Connected Toaster. This Bluetooth toaster syncs up with a smartphone app, with which you can dial in your precise toast settings. Need that perfect toast again? No problem; the app remembers the settings. (Wait, isn't that what the rotary dial on a toaster does?) But for \$100.00, you do get this cool-looking appliance.

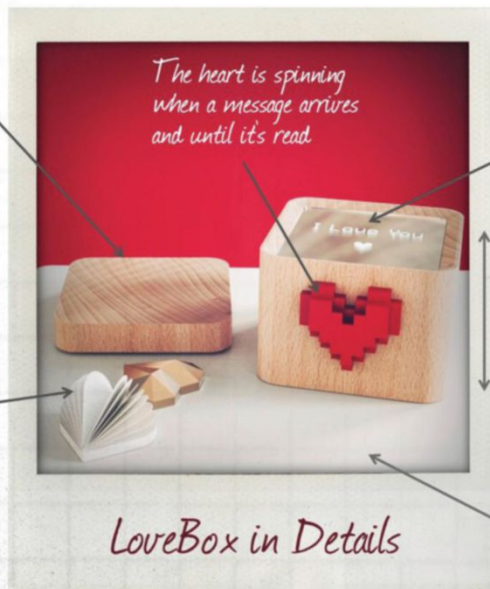
The LoveBox

This little wooden trinket box connects to the Internet and works with a mobile app. When you get a new message, the heart on the front spins and the text appears in a mirror on the top of the box. It's just \$99.00.



LoveBox is made out of a solid piece of beech wood from Jura

Choose from three different hearts to personalize your LoveBox



LoveBox in Details

Your secret message is sent from the LoveBox mobile app and magically appears in the screen covered by a mirror

8 cm

Located near you, on your bedside table plugged into a power outlet and connected to a WiFi

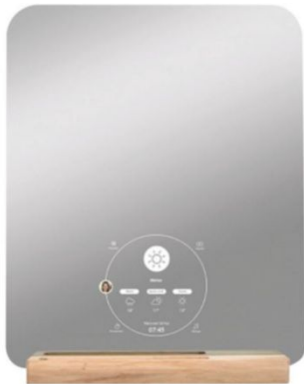


Airdog Fitair

How about some fresh air? All you have to do is strap this \$100.00 device on your face and the air is delivered fresh and clean. Now, if it only came with a Darth Vader voice...

Don't Trash That!

Getting ready to throw something away but you wonder if it is worth something or is recyclable? Well, now, you can use Eugene to scan the bar code on the package and tell you. Of course, this is assuming your trash has a bar code on it. For just \$99.00, you don't need to squint anymore to see the recycling label on the container.



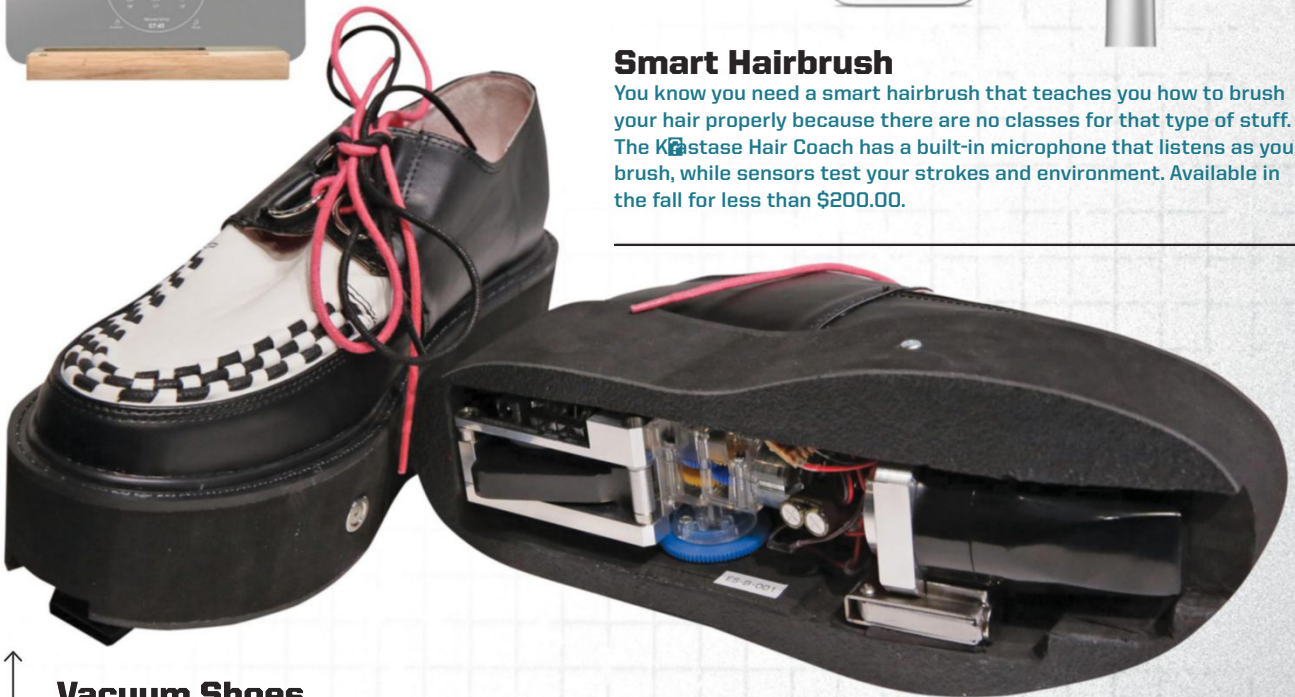
Smart Mirror

Have you thought your mirror should be used for more than grooming and assembling outfits? Then this is the mirror for you. The Ekko smart mirror plays music and videos, displays the news, tells the time, and much more. It will only set you back \$399.00.



Smart Hairbrush

You know you need a smart hairbrush that teaches you how to brush your hair properly because there are no classes for that type of stuff. The Kestase Hair Coach has a built-in microphone that listens as you brush, while sensors test your strokes and environment. Available in the fall for less than \$200.00.



Vacuum Shoes

Now you can look good *and* have a clean floor! Yes, these are vacuum shoes, and they don't use batteries. Every time you take a step and press down on the pedal (sole), the motor is powered and sucks up dirt into a small internal dustbin. Sadly, there is no word on availability.



Attendees got the chance to test out the latest new technology. Virtual-reality goggles were a hit!

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You might have heard that Polaroid is a lost brand, but don't count it out just yet. Polaroid was at the show, with its vintage look updated for the digital age. The Polaroid Pop can produce a print just like the traditional Polaroid did, but this version also saves a digital copy. It has a 20-megapixel camera and a 3.97-inch LCD touchscreen.



Many of the booths had interactive displays and ways for attendees to try out the products. Here, at the Voxxx booth, there were different methods to enjoy the music and have some fun while learning about the product. ✚

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Getting into Electric-Ducted-Fan Jets



Jets like the A-10 Warthog make great electric-powered modeling subjects, and they don't necessarily need to be high-dollar, high-voltage projects. (Photo by Jim Haseltine)

At last spring's Toledo RC Show, I was talking to my friend Dave Grife about upcoming plans for modeling projects. Dave has done several impressive scale jet models using electric ducted fans (EDFs) for power and was trying to convince me to give one a try. My main area of interest is in large World War II-era planes, and I try to avoid getting into expensive new facets of the RC hobby. With that in mind, I attempted to weasel out of a commitment by saying that I'd only be interested in doing an EDF if an 80-inch-wingspan A-10 model was available. That's when someone who was listening mentioned that RC Aerodyne (scaleflying.com) had recently introduced a nice, fully molded A-10 model with a wingspan of 82 inches. Because I do love the A-10—and really meant what I had said—I decided to check it out.

Sure enough, RC Aerodyne has a molded ARF A-10 model produced by Roban that meets my size preferences, and the cost of the kit includes electric-powered retracts and

lots of scale details. With an anticipated all-up weight about 25 pounds, it's designed to be powered by two 120mm EDF units, which is a completely new thing for me, so I started doing some research.

POWER REQUIREMENTS

If I were planning power for a propeller-driven model, I'd use the traditional watts-per-pound guideline that has been detailed previously in this magazine and column. I've done those calculations many times before and successfully assembled my own power systems. But EDF power systems don't have the same rules and conventions, and measurements like static thrust and exhaust air speed (known as efflux velocity) come into play. I'm no engineer—and I certainly don't have the skills to figure these things out myself—but fortunately, there are several companies who make fan assemblies in the size I need. I followed Dave's recommendation and looked up information about the Jetfan-120 ECO (at

Fan Jets USA, rc-electric-jets.com). This fan and housing are constructed out of molded carbon-fiber-reinforced plastic. The 11-blade rotor is dynamically balanced, with an aluminum hub and a collet-style motor adapter. Charts online show lots of information and test results, which help you choose a motor and battery combination.

One of the things that kept me from trying an EDF model before was my dislike of high-current power systems. I've always thought that EDFs were all high-current monsters. As I looked through the data in the Jetfan-120 chart, I saw that, for my application, this didn't have to be true. I found a motor/battery combination that used 12 cells per fan and developed 12.5 pounds of thrust on less than 75 amps. With two fans working, that will give the A-10 a 1:1 thrust-to-weight ratio, and from what I've learned, that's a good thing.

AIRFLOW

Another of the differences between prop-driven

Mounted in the A-10 nacelle, this photo shows a nice smooth transition between the electric-ducted-fan (EDF) housing and the inlet lip. It also illustrates the fan-swept area (FSA), where the dark area in the center of the EDF, the rotor hub, and motor blocks airflow from the center.

models and EDFs is that you can't just toss a fan assembly into a plane and have it work well. Consideration has to be given to the airflow, both into the fan and out the rear of the airplane or nacelle. Less turbulent, relatively undisturbed airflow on both sides of the EDF will result in better efficiency and power delivery.

For the inlets into the nacelles, the A-10 comes with molded fiberglass inlet rings. Having been designed for a different fan, it turns out they're a little too large for the outer diameter of the Jetfan housings. There were several options for making the inlet rings fit, including making new ones. I ended up trimming a curved, molded plastic intake ring that Jetfan makes and that fit the fan housing perfectly. Cutting and sanding carefully, I was able to fit and glue it into the fiberglass inlet rings so that the inlets fair smoothly into the fan housing.

The exit, or efflux, airstream has to be directed out of the airplane in a coherent flow, and the full-size A-10 jet engines used an exhaust with about 5 degrees of upward deflection. I decided the model might benefit from that upthrust as well, so I tried to figure out how to do it. Again, there were several possibilities, but a conversation with CAD master and Air Age contributor Jim Ryan decided the issue for me. He suggested Mylar efflux tubes and offered, if I could give him the necessary dimensions, to draw patterns for them that would make the conical shape I needed.

One of the variables that EDFs bring into consideration is the size of the efflux-tube exit,



which is commonly referred to as the fan-swept area (FSA) of the fan. FSA is the annular, or donut-shaped, portion that is the path the fan blades move through in the EDF housing. FSA is calculated by subtracting the small circular area of the rotor hub or motor, which blocks airflow, from the larger circular area of the fan diameter.

Once the FSA for a fan is known, the area of the efflux exit can be calculated as a percentage of FSA. Many EDF models use a reduced efflux diameter to increase the exiting airspeed, or efflux velocity, to give the model a higher airspeed. This comes at the cost of lower static thrust and higher motor current from the increased load. A general rule I've seen is for



The heavy Mylar efflux tube mates to the EDF housing by way of a thin plywood adapter ring. A stop ring along the centerline keeps it all aligned and airtight.

This photo shows the completed EDF unit. The modified inlet ring fits tightly to the front of the fan, and the efflux tube will guide the exhaust in a clean column for efficient thrust and power.



Venom's UNI 2.0 connector set includes two well-constructed adapters to go from the XT60 plug on the battery to Deans or EC3 connectors. The balance tap connector is a standard JST-XH plug.

the area to be in a range of 80 to 90 percent of FSA, with the smaller area used for more speed and the larger one for more thrust. What works best in a given situation depends on the design of the fan in question. I did some research online and found that the designer of the Jetfan-120, Rainer Holzmann, recommends a larger efflux area that is just about equal to FSA for this fan, so that's the dimension I used.

Once I got the correct measurements to Jim, he designed a pattern for the efflux tubes that gave me the upthrust I was looking for. To attach them to the EDF housings, I needed to make adapters. I covered a fan housing with plastic wrap and made up a 1/64-inch plywood ring that fit tightly around the housing, about 3/4 inch wide. I laminated another narrow plywood ring around the inside centerline of the first to act as a stop for both the Mylar efflux tube and the EDF housing. The conical Mylar efflux tube fits the adapter ring perfectly, and the connection between the fan and tube is neat and airtight.

BOTTOM LINE

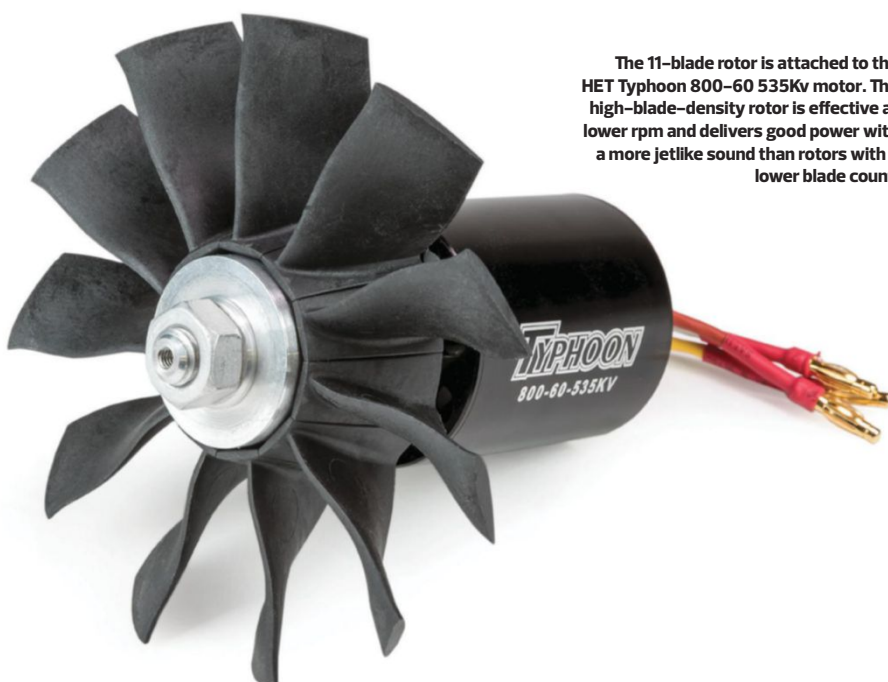
With the nacelles set up, there's still quite a bit of the usual ARF assembly work to do and that's the same regardless of propulsion method. I have to admit that it's been very interesting and fun to investigate another niche of this electric RC hobby. I've started to think of EDFs as a more feasible option for myself, and I'm looking forward to seeing how this A-10 works out and maybe trying one or two more. ✚

Venom Fly LiPo Batteries

I recently got a set of batteries from Venom Power for the Roban A-10 project, and I was pleasantly surprised by them. The Venom Fly 6S 5000mAh 30C batteries are smaller and lighter when compared with similar batteries I've used. I weighed a few packs and checked, and the Venoms are 3 to 5 ounces lighter than the other 6S 5Ah batteries I use regularly. For the A-10 project, that's as much as a pound lighter for the full battery load, which is a significant weight savings.

I was also impressed when I looked at the power leads. These packs come equipped with Venom's patented UNI 2.0 plug system, which means that the batteries have a nice Amass XT60 plug factory installed on the power leads, and there are two one-piece adapters included. One adapter is for Deans-style T connectors, and the other is for Horizon's EC3 connectors. Between the three included connector types, Venom takes care of the needs of many modelers right out of the box.

The 30C continuous and 50C burst discharge rates and up to 5C maximum charge rate will far exceed my needs for a long time to come. Venom has a wide range of batteries available at venompower.com.



The 11-blade rotor is attached to the HET Typhoon 800-60 535Kv motor. The high-blade-density rotor is effective at lower rpm and delivers good power with a more jetlike sound than rotors with a lower blade count.

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Venom Pro Quad 100W X4

FOUR IMPRESSIVE CHARGERS IN ONE SPACE-SAVING LAYOUT

BY GERRY YARRISH

PHOTOS BY PETER HALL

Featuring four individual charging circuits, the Venom Pro Quad builds on much of the success of the Pro Duo twin battery charger. Built in a workbench space-saving vertical layout, it is easy to use, with each charging output having its own integrated 100W power supply. Intended for the serious electric-airplane builder and flier who has a large selection of battery packs to manage, the Venom Pro Quad is a multiple-chemistry battery-charging system, which can charge Li-Ion, LiPo, LiHV, LiFe, NiMH, Ni-Cd, and lead-acid (Pb) battery types. It monitors and balances individual cells within LiPo packs in either charge or discharge modes for up to four 6S LiPo battery packs at a time. It can also safely charge or discharge up to 15-cell NiMH or Ni-Cd battery packs. Nicely designed in a rugged, molded-plastic case, the Pro Quad comes with everything you need to start charging all your battery packs. Let's take a closer look at this impressive quad charger.

UNIQUE FEATURES

On the back of the charger case (keeping your wires and power cords out of the way on the workbench), you'll find dual cooling fans, both an AC and a DC power inlet, and two 5.3V/2.3A USB ports to keep your USB-powered devices powered up. On the business end of the Pro Quad are the main display, four channel light indicators, the Select/Stop button to choose the main program and stop the operation, an increase and a decrease button to alter values and to select subprograms, and the Start/Enter button to resume or start the operation. Below these four buttons is the channel-select button to call up the display for each of the charging channels. On the lower half of the front panel



Housed in a vertical format case, the Venom Pro Quad 100W X4 offers a lot of charging power but does not take up a lot of workbench space.

are the four groups of dual 4mm banana female jacks for the charging leads, and below these are the four ports for the balance-board inputs.

Several charging cords are also included with connectors for EC5, EC3, Deans, Tamiya, and XT60 alligator clips; an RC receiver battery plug; and JST plugs.

INITIAL SETUP

It is very important to properly set the charger for the lithium battery type you are using as the nominal voltage for each varies with type. Li-Ion is 3.6V, LiPo is 3.7V, LiHV is 3.8V, and LiFe is 3.3V per cell. In use, the charger will use the default values when first powered up and you connect the battery pack and select the charging channel. To change the values, press

the Start/Enter button once; the screen will display the values, and the value to be adjusted will blink. You can then use the Inc/Dec buttons to adjust the values. After adjusting the value, pressing the Start/Enter button again saves the value and makes the next value to be edited flash. You again can increase or decrease this value. Once all the values have been selected, press and hold the Start/Enter button; the display goes to the Confirm charging screen, with a final warning to press Enter again to begin. This gives you the opportunity to double-check your charger settings. There are two values shown: the "R" value shows the number of cells detected by the charger, and the "S" value is the number of cells you've selected. Both values should match. If they do not, press



The back panel of the charger case has all the power ports and two efficient cooling fans.

the Battery Type/Stop button and check the value you entered. If it is correct, then there is a problem with your battery pack, and it should not be charged. If everything is good, then press and hold the Start/Enter button to start the charge sequence.

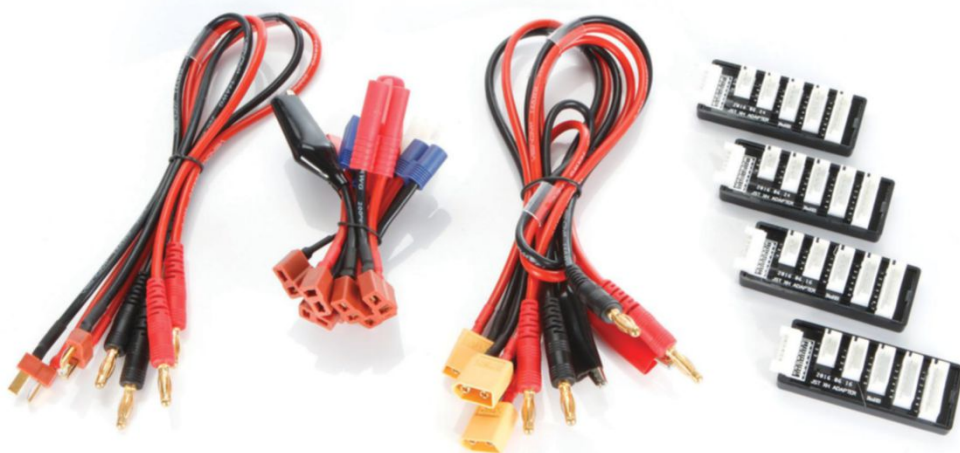
During the charge cycle, the display shows the battery type and cell count, the amp setting, and the voltage. On a second line, it displays the charge time and the mAh (amount of charged capacity the charger has put into your pack). Pressing the Battery Type/Stop button ends the charge cycle.

TYPES OF CHARGE

For lithium batteries, you can use the Normal (default), Fast, or Storage charge setting. With Normal charge, the charging current will begin to drop as the battery reaches its nominal voltage. When using the Fast charge option, this reduction of power will not be as great as it is with the standard Normal charge. The benefit is

that the pack will have a reduced charge time, but it is most likely that it will not be charged to its fullest capacity, so it is a tradeoff. If your battery pack will be sitting unused for some time, it is best to give the pack a Storage charge. This will charge the battery to a nominal storage voltage per cell (3.75V for LiPo and Li-Ion, 3.80V for LiHV, and 3.3V for LiFe). The charger will automatically determine if the battery needs to be charged or discharged to reach these levels.

When it comes to charging and discharging lithium batteries as well as other types, the user manual has excellent instructions as well as illustrations of the display screens and a flowchart to guide you through the process. Other useful functions include Battery Meter testing, which can be used for battery-pack diagnostics as well as data storage for up to five packs. There are also several warning and error messages that will help you avoid damaging your equipment or battery packs.



The charging cables and four balance boards that come with the Pro Quad take care of just about any type of popular battery pack you'd like to charge.



While charging, you can press the Increase button to display the individual cell voltages for the battery pack. Pressing it again returns you to the main display, showing battery type, cell count, amp setting, voltage, charge time, and mAh.

SPECIFICATIONS

Model: Pro Quad 100W X4

Manufacturer: Venom Power (venompower.com)

Dual input (AC/DC): 100-240V/11-18V

Circuit power: Max 100W for charging (x4); max 5W for discharging (x4)

Charge current range: 0.1-7.0A (x4)

Discharge current range: 0.1-1.0A (x4)

Battery types: LiPo/Li-Ion/LiHV/LiFe; NiMH/Ni-Cd; Pb

Cell counts: LiPo/Li-Ion/LiHV/LiFe, 1-6; NiMH/Ni-Cd, 1-15

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- Instructions

HIGHLIGHTS

- Circuit power: 4 x 100W
- 5-button control interface
- Easy-to-read backlit LCD screen
- Easy program-menu navigation

BOTTOM LINE

I have found all Venom chargers very easy to use, having excellent dependability and durability. Overall, I think the new Venom Pro Quad is an excellent piece of shop equipment, which saves workbench space and can be considered a good investment for the modeler needing to manage several battery packs of varying types and capacities. ±

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GOOD HABITS

It's not how you start that counts, it's how you finish!

TEXT & ILLUSTRATIONS BY **DAVID SCOTT**

If you have read my articles over the years, you might recall that I derive my content from nearly three decades of training at my 1st U.S. R/C Flight School's four-day accelerated courses. Initially, the flight school mainly trained primary students through solo. But as the number of graduates grew to more than 1,000, the focus has shifted to mainly aerobatic instruction to meet the demand of prior enrollees wanting more advanced training.



Traditionally, recreational pilots have relied on trial and error or learning from their mistakes when seeking to improve their aerobatic skills. Hence, most pilots think that the only way to improve their flying is through large quantities of practice. Having a four-day course deadline, however, has a way of focusing attention on the things that matter most to ensure that pilots learn at a faster rate.

The great news is that while the equipment we fly keeps becoming more complicated, the keys to accelerated learning are not at all complicated and can be easily adopted by almost any pilot. In a nutshell, my instruction is based on breaking up each maneuver into its component parts and then introducing them to the student in a crawl-walk-run format. The secret sauce is knowing what certain pilots do that causes them to excel while other pilots with the same or more experience struggle to improve and often plateau.

Two of the most important characteristics of proficient aerobatic pilots are consistent wings-level entries into maneuvers (i.e., starting off each maneuver on the right track) and holding off on trying to fly a perfect maneuver until it's known how the airplane reacts (i.e., initially refraining from trying to correct/fix deviations or add refinements). I will discuss the importance of wings-level entries shortly, but first, let me address the so-called "do not fix" approach. This method is based on the fact that the airplane is often the best teacher, and if you allow it to, it will show you what you need to do to rapidly improve your maneuvers.

FIDDLING IS THE ENEMY OF PROGRESS

One of the biggest obstacles to efficient learning is the tendency of RC pilots to skip the crawl-walk stage and immediately try to run when learning to fly a new maneuver or a familiar maneuver with a new plane. That is, they immediately attempt to correct every deviation they see during the maneuver. The problem with that approach is that, by the time the maneuver is completed (often poorly), so many adjustments have been made that it's nearly impossible to decipher why so many corrections were needed or what needs to be done differently the next time around.

A larger problem is that no two attempts at the same maneuver ever turn out the same. The lack of consistency sets a progress-killing precedent that causes pilots to assume that constant corrections are standard when flying aerobatics. As such, most pilots seek to improve their flying by trying to get better at reacting to deviations. (That's why I'm not worried about "giving away the store" when

revealing the following school training technique because the only fliers likely to try it are those who've come to the realization that they are in need of a fresh approach.)

A SIMPLE SOLUTION

The "do not fix" approach is based on the winning mindset that "It's not how you start that counts, it's how you finish!" Hence, when I teach precision aerobatics, I introduce each new lesson by walking students step by step through the basic execution. I then explain that every airplane will consistently exhibit certain tendencies (deviations) every time the maneuver is performed. Thus, to master the maneuver, we must first focus on the basic execution (crawl), and when the first deviation is noted, store it in your mind for later (Figure 1).

At the flight school, we call these early attempts "mulligans" (i.e., we're not scoring them yet). And contrary to what club pilots think is ideal, our best-case scenario is when a deviation is highly obvious. That way, there's never any doubt in the pilot's mind about what

YOU CAN IMPROVE QUICKLY AS LONG AS YOU LEARN THE BASIC STEP-BY-STEP EXECUTION OF EACH MANEUVER BEFOREHAND. YOU ALSO NEED TO BE ABLE TO REFRAIN INITIALLY FROM TRYING TO CORRECT EVERY DEVIATION OR FROM ADDING REFINEMENTS BUT, INSTEAD, ALLOW THE AIRPLANE TO SHOW YOU WHAT IS NEEDED.

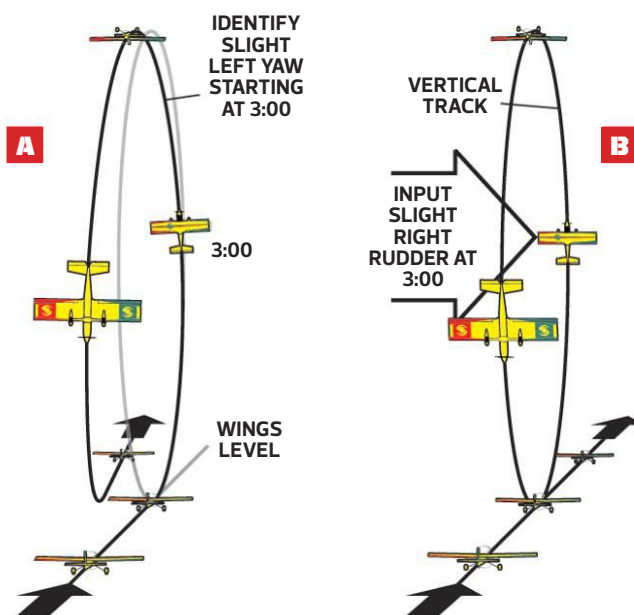


Figure 1

It's not how you start that counts, it's how you finish! By initially focusing on the basic execution of the maneuver and holding off on correcting deviations or adding refinements, the plane will show you what is needed. Once those observations are made, you will be able to consistently anticipate corrections to prevent deviations from happening in the first place.

has to be done to improve the maneuver. Even when the need for a correction is obvious, however, I instruct my students to refrain from adding it for a few more attempts. That's because it is not enough just to recognize the need for a correction. We also need to identify when the deviation occurs and how severe it is to anticipate the timing and size of the correction input (walk). Without knowing those aspects ahead of time, nearly every student will default to inputting the correction too early and too much.

When the correction is added, pilots discover how much nicer and easier the maneuver is when the deviation is prevented as opposed to trying to return the airplane back to where it belongs after a noticeable deviation. As a result, the number of "brain bytes" required to execute the maneuver is kept to a minimum, thus enabling pilots to start noticing other areas that can be improved (run). If no other corrections are needed, the remaining untapped brain bytes can then be applied to learning another maneuver dealing with wind, fine-tuning the plane's handling, and so on.

By the way, this is primarily why kids learn so quickly: While adults are prone to thinking about "what ifs" and putting pressure on themselves to do the best they can right away, kids are a blank slate and tend to approach new things with a "let's see what happens" attitude. By not biting off more than they can chew, kids will "notice" that a particular deviation occurs every time the maneuver is performed. Once that registers, their subconscious mind takes over, and they begin automatically inputting the correction (giving the appearance of super-keen eyesight and lightning-fast reflexes). Also, preventing a deviation early in the maneuver quite often reduces or eliminates the need for additional corrections. The reason they make it look so easy is because it is!

This game-changing training technique is not complicated (just the opposite) and does not depend on quick reflexes or flying several days a week, so there should be no reason why adult club fliers can't experience the same rapid improvement. You can improve quickly as long as you learn the basic step-by-step execution of each maneuver beforehand. You also need to be able to refrain initially from trying to correct every deviation or from adding refinements but, instead, allow the airplane to show you what is needed.

This approach is especially important in the sport today because the emphasis on modern technology is supplanting many bedrock airplane design and setup principles. As a result, some traditional rules of thumb often no longer apply.

Allow me to explain. Back in the day, guys who flew "free-flight" models had to learn how to properly configure and trim an airplane because they had no control after launching it.

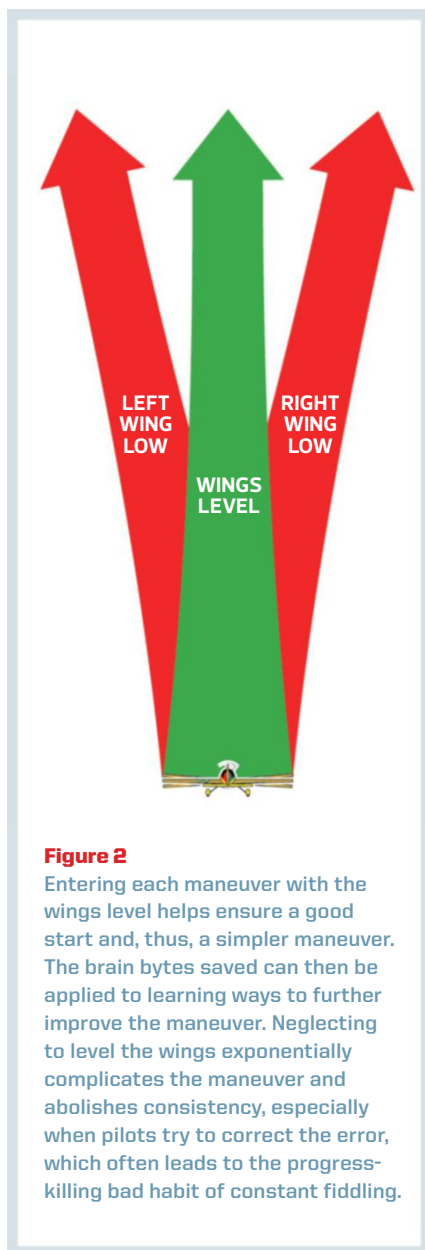


Figure 2

Entering each maneuver with the wings level helps ensure a good start and, thus, a simpler maneuver. The brain bytes saved can then be applied to learning ways to further improve the maneuver. Neglecting to level the wings exponentially complicates the maneuver and abolishes consistency, especially when pilots try to correct the error, which often leads to the progress-killing bad habit of constant fiddling.

Consequently, when they became RC pilots, they shared those essential fundamentals with others. Those fundamentals then became the foundation of almost all RC plane setups until the end of the century. Therefore, pilots became used to their planes displaying certain characteristics. Loops, for example, were expected to tighten approaching the top due to the effect of gravity; so if a pilot wanted to fly a round loop, he had to take out a little elevator to "float" over the top. Or if a plane was rolled inverted on a 45-degree upline, some forward elevator was needed to prevent the line from becoming shallow. Planes were also expected to yaw to the left near the tops of loops and vertical uplines due to propwash (sometimes mistakenly called "torque"); thus,

right rudder was typically needed to maintain the proper track.

For a whole host of reasons, however, it is quite common these days to come across airplanes that do just the opposite of convention. You might discover, for example, that your loops grow flatter on top as opposed to becoming tighter, thus requiring you to pull more elevator over the top to keep the loop round. Or your plane might pitch up more steeply after rolling inverted on a sustained 45-degree upline instead of dropping.

As awkward as these events would seem to a veteran pilot, these breaks from convention, in theory, shouldn't be a problem for those who use the crawl-walk-run approach. Specifically, your initial mulligans will keep you from inputting the wrong corrections just because someone told you that the maneuver required them.

THE WINGS-LEVEL IMPERATIVE

There is an essential element that must be part of your maneuvers for you to achieve the consistency needed to detect and predictably prevent the deviations associated with each maneuver: Each must be entered with the wings level. That ensures that the airplane will, at least, start out tracking vertically during looping maneuvers and help prevent other maneuvers from veering off to one side (Figure 2).

Of course, if you entered a maneuver without level wings, you could try to correct during the maneuver. But then you'd have to expect your flying to stagnate as a result of exhausting most of your brain bytes by fiddling with the ailerons. Plus, the resulting inconsistency would make it nearly impossible to identify the plane's tendencies or even cause you to misdiagnose your plane's tendencies. In short, like everything else in life, it's far easier to do things the correct way and avoid a problem than it is to try to correct after the damage is done!

Before you claim that it's sometimes hard to judge whether the wings are level, I can tell you that there's a solution (and it's not going to see your eye doctor or traveling back in time to when you were younger). Pilots fail to level the wings for the same reason that they fail to maintain good positioning; they get ahead of themselves or divide their attention among too many things and, thus, neglect to place enough emphasis on it.

For example, a by-product of four-day accelerated training, in which new lessons are constantly being introduced, is that sometimes students will neglect to level the wings before entering a maneuver. After the subsequent poor result, students will usually say that they thought the wings were level even though they clearly were not (aka "wishful thinking"). Knowing that every attempt without level wings will prove to be a waste of valuable

time—or worse, negative reinforcement—I bring out a small buzzer and step on it each time a maneuver is started without the wings level (a buzzer is more humane than an electric-shock collar). As a result, my students become hyperfocused on making sure that their wings are level to avoid hearing that dang buzzer, and because of that, their wings are level 99 percent of the time! Consequently, their practice is so much more consistent and efficient that they start recognizing all sorts of ways that the maneuvers can be improved. (That's when I joke about us having witnessed the miracle of instantaneous improved eyesight and ability.)

Another version of this technique involves me waving a dollar bill in front of students while they're flying and saying, "I'll bet you a dollar that, if you set your mind to it, you can enter each maneuver with the wings level for the rest of the flight. But if you don't, you owe me a dollar." Of course, I lose the bet almost every time. But it's definitely worth it when suddenly everything seems like it's happening slower after the number of inputs the student has to make are cut in half, thus making things easier on both of us.

In fact, the improvement after a student starts prioritizing level wings is so obvious to

EXECUTING CONSISTENT WINGS-LEVEL ENTRY IS NOT DIFFICULT; RATHER, IT'S A DECISION THAT WILL CAUSE A LOT OF OTHER THINGS TO THEN FALL INTO PLACE.

the other students watching that the whole class will often start making bets among themselves as a way of incentivizing each other to do better in key areas. All this is to say that executing consistent wings-level entry is not difficult; rather, it's a decision that will cause a lot of other things to then fall into place. (By the way, at the end of the day, everybody gives the dollar back or puts it into a lunch fund because it's the outcomes we are all after, not the money.)

BOTTOM LINE

The best club pilots you know are likely better than everyone else at reacting to deviations, but as they will tell you, it took untold hours of practice to develop those skills. That's largely because they are often too busy making

corrections to think about how they might be prevented in the first place (it's also why they usually can't tell you specifically what they do). Proficient pilots (the ones who make everything look easy) use their initial practice to pinpoint what they need to do to make significant strides in just a few attempts. As more consistent fliers, they also use fewer brain bytes and, thus, are more open to taking on new challenges.

That said, I know that most pilots are inclined to think that the way they approach flying works best for them—that is, they only need to practice more. If you are one of those pilots who takes a long time to adapt to a new plane or learn a new maneuver, if you're uncomfortable flying in winds more than 10mph, or if you take more than a day to set up a new plane to achieve optimal handling, those shortcomings are reflective of your current approach maxing out your brain bytes. Consequently, it only takes the introduction of one variable to bog you down indefinitely. If you wish to do better, the habits featured here and over the next several months will enable you to enjoy flying more than you ever thought possible. Flying is, after all, the most fun when you're doing well and making progress! ✚



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LET'S TALK GIANT SCALE

BY JOHN GLEZELLIS

When flying a variety of different aircraft, identifying and implementing common programming techniques across each airplane will help a pilot transition from one model to the next.



Fly Easier with Flight-Mode Switches

For giant-scale enthusiasts—and all model airplane aficionados for that matter—flight consistency is one of the most challenging skills to obtain. If you are like me, you have a diverse fleet of models in your hangar, ranging from slow-flying pre-World War I airplanes to modern-day aerobats and perhaps a turbine-powered jet thrown in for good measure. It is also important to establish common themes in how each plane is programmed with high-end computer radio systems. This month, let's look at how to analyze the flight characteristics of your models to identify which switches and functions are required. Using the functions that most high-end radio systems offer will decrease your workload so that you can focus on flying with consistent control.

SWITCH IDENTIFICATION

It is important to note that no two pilots fly exactly the same. But certain steps can be taken so that the particular aircraft being flown responds consistently to your inputs. While some pilots prefer to have a separate switch to control different functions, it can be difficult, when something goes wrong, to remember the locations and functions of each switch. Here's how I do it.

First, hold the transmitter and see where

your fingers are positioned naturally. I am a Mode 2 thumb flier, so my index fingers are directly in front of Switch G and Switch B on the my Spektrum DX18 transmitter. These are two switches on the top of the transmitter that are closest to the pilot. With my fingers in these positions, I use Switch G for all my flight modes, no matter what type of aircraft I am flying. For airplanes with retractable landing gear and flaps, I use Switch D, which is directly above the throttle stick, to control the flaps, and Switch A,

which is where my left ring finger is located, to control the landing gear. I have the flap switch directly above the throttle so that I can quickly find and activate it during flight. I can access this switch and each position without repositioning my right hand, which is on the right stick. If you prefer another mode or you hold your transmitter in a different manner, assess whatever switches cater to your needs. Now that we've identified a few switches, let's look at some functions that differ from one airplane to the next.

PROGRAMMING FUNDAMENTALS

On a model like a 1/3-scale Sopwith Pup or a Piper J-3 Cub, in which the aircraft only has basic control functions with no additional scale features, one switch can be used to control a variety of functions as different control deflection amounts are often favorable for certain maneuvers.

For example, some prefer less rudder travel for takeoff mode to prevent overcorrection in yaw as the airplane is getting up to speed. Additionally, some pilots favor more elevator

deflection on this rate compared to their normal flight rate to prevent a nose-over when flying off a grass runway. Using a specific flight mode simplifies this process and is much better than having to search for the elevator and rudder dual-rates switches, all while the model is transitioning from a stop to takeoff speeds. The pilot then only needs to use and focus on a single switch. Once in the air, you can then switch to your normal flight mode.

When flying an airplane with a light wing loading, making a 360-degree turn might require both aileron and rudder inputs to make a smooth coordinated turn. While this can be done with manual pilot input, it can also be done with a programmable mix, which again simplifies pilot workload. You could use a mixer to incorporate the required amount of rudder deflection when aileron is commanded. More rudder input is required at slower flight speeds compared to faster speeds, and the amount of rudder will hinge on the aircraft configuration. By using a curve mix, you can set individual points throughout the movement of the aileron stick to incorporate different amounts

MAKING A 360-DEGREE TURN REQUIRING BOTH AILERON AND RUDDER INPUTS CAN BE DONE WITH MANUAL PILOT INPUT, OR IT CAN BE DONE WITH A PROGRAMMABLE MIX, WHICH SIMPLIFIES PILOT WORKLOAD.

of rudder at specific points throughout the mix curve. You can test this mix by executing a horizontal upright level pass at cruise power and by moving the aileron stick in a gentle manner from side to side and noting the plane's heading. If it tracks in a relatively straight line, the mix percentage is correct. Otherwise, some tuning is required.

A mixer can be activated all the time or assigned to a switch. For a model like a J-3, where only one or two rates might be needed for control surface deflection amounts, you can assign this mix to the same switch as the flight mode used for normal flight because automatic rudder input might be undesirable when aileron is commanded during a crosswind.

Also, some pilots prefer to use two different idle settings that correspond to normal flight as well as a landing mode. While a standard two-position switch can be used for this mix, you can go a simpler route and use two identical throttle curves (with the exception of the lowest point on each throttle curve) and assign these curves to the flight-mode switch. One position would feature a lower idle point compared to the other and then be assigned to

By using the information in this column as a guide, one can enjoy the pure flight characteristics of a model like this beautiful giant-scale Sopwith Pup with a mere flip of a switch!



On models that feature retractable landing gear, I always prefer to keep the landing gear on a separate switch. Flaps and rates, however, could be incorporated on a single switch for added simplicity depending on the personal preferences of the pilot.

the flight-mode switch. Low idle is preferred for the ground-handling and landing modes, and a higher idle is generally used for flight to prevent an engine flameout.

COMPLEX AIRCRAFT

Next, let's look at a scale WW II model that features retractable landing gear, a sliding canopy, lights, and flaps—pretty complex, to say the least! Obviously, separate switches can

be assigned and used for each function, but remembering each switch location, position, and function can easily become quite a challenge. I prefer to have the landing gear, flaps, and flight modes on separate switches. Then, when you're activating lights and sliding canopies or any other advanced feature, each can be coupled to a switch that is already being used.

As an example, you might want to have the lights on and the canopy in the open position

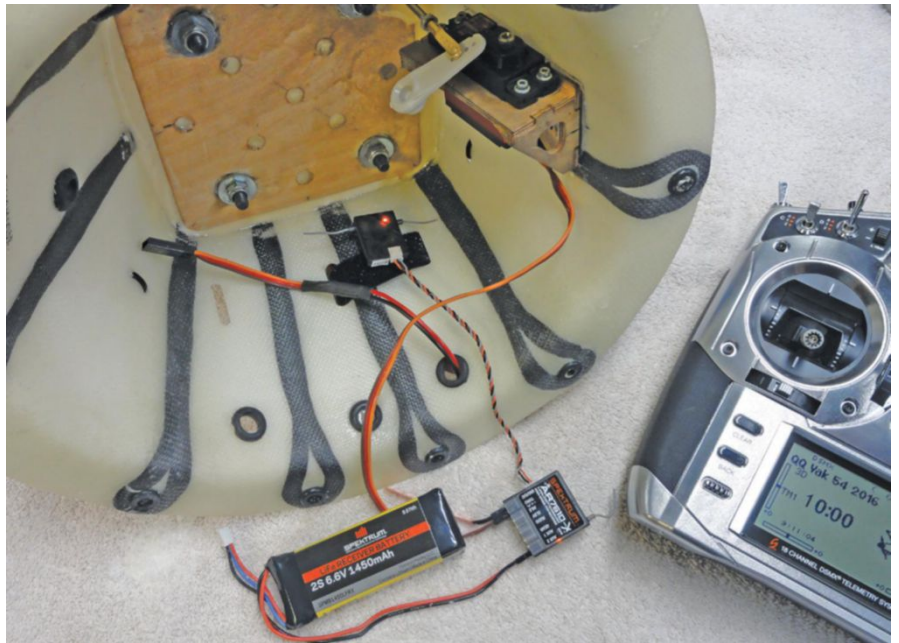
LET'S TALK GIANT SCALE

while the aircraft is on the ground. For the DX18, I can assign the receiver port that activates the canopy to a particular switch; independently adjusted endpoint travel for this function can then be used for servo speed and so on.

I assign the canopy function to the flight mode used for ground handling. If this were activated with Switch G, it can be open in the switch's Position 2 and closed in Position 1, which is used during flight. A second switch could also be used for the flaps as well as any lighting functions, like the landing lights. I program the aircraft using a curve mix so that when the flaps are partially deflected, the lights are also activated.

Once in the air, I retract the landing gear, which I always assign to a completely separate switch. Flaps will return to their normal flight position and the lights might change or go out depending on the desired situation. By experimenting with different mixers and the separate modes that are to be used in flight, a lot of functionality can be coupled with one or two switch positions.

Another example is during slow passes, when you might want to have flaps at max deflection, landing gear down, and the lights



Shown here, the throttle arm has been removed to view the movement of the linkage to properly set the high- and low- idle settings as discussed in this column.

on. Usually when the flaps are deflected, the aircraft might pitch upward, having an impact on the flight characteristics of the airplane. In this case, you can mix in the required amount of down-elevator trim during flap deflections and eliminate the need for manual pilot-applied corrections.

Finally, when setting up for a landing approach, I prefer to drop the landing gear and then partially lower the flaps. As I turn from base to final, I extend the flaps to their maximum amount. Once the aircraft is on the ground, I

return the flight-mode switch to Position 2 for higher deflection rates and open the canopy.

FINAL THOUGHTS

It is important to realize that all pilots have different preferences, and my suggestions should only serve as a guide to provide insight for what's possible. In the end, minimizing your workload and simplifying switch activation will let you concentrate on what's most important: controlling and flying your airplane. ✈



With deflection from the flap servos, a slight amount of elevator can be applied from the computer radio system to eliminate the need of having the pilot manually apply corrective inputs.



Assigning all control surfaces to a flight mode allows one to control all control surfaces and deflection amounts with the flip of a single switch.



Assign different lighting functions to either a flight mode or flap switch to eliminate the need for another switch that is intended solely for the lighting system.

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DRONE WORLD Falcon Edition

The best DJI Phantom 4 package you can get!

BY JOHN REID PHOTOS BY LESLEY CUNNINGHAM GREENLEE

When looking to get into the world of drone videography, sometimes it is less expensive to get everything you need in one package. One of the best packages you can get is from Drone World, whose modified Phantom 4 Falcon Edition is much more than a stock setup.

HIGHLIGHTS

The Falcon Edition comes with everything you need to start shooting. Included is a Phantom 4, three batteries, a Thor charger that can charge all the batteries and the controller at the same time, a highly modified FireBridge remote-control system, a Nanuk 950 hard wheeled case, extra carbon-fiber propellers, propeller guards, an L-series premium lens filter kit (variable polarizer and neutral density), 64GB and 16GB micro SD memory cards, a battery bank, a Drone World tablet sunshade, a remote lanyard, an Apple USB cable, a Falcon drone skin wrap, a car charger, and more. While that is a lot for the price, the real killer is the FireBridge remote control with fully internalized Wi-Fi boosters.

This controller has a custom cooling system, military-grade

wiring, and dual helicoil antennae, which increase the telemetry range to four to five miles. (Why would you need that? Check out the sidebar to see why this is a good thing.) Of course, the Phantom 4 has all the great things you want in a quad of this caliber: obstacle avoidance, tracking on moving subjects, flying to a location by tapping on the tablet screen, 20- to 28-minute flight times, smart return to home, and the ability to avoid obstacles on the way back. The really nice thing about this system is the custom case that is included. Everything has a place, and it is easy to keep all the things you need for safe transportation to the flying site. This system would be perfect for an accomplished drone pilot who is looking to move up to a higher-quality setup for filming and photography.

SPECIFICATIONS

MODEL: Phantom 4 Falcon Edition

MANUFACTURER: DJI (dji.com)

DISTRIBUTOR: Drone World (drone-world.com)

TYPE: Camera rig

SIZE: 350mm

WEIGHT: 3 lb.

MOTORS: Installed and included

BATTERY: 2S 6000mAh (three included)

FLIGHT CONTROLLER: Installed and included

RADIO: Engineered DJI with FireBridge Technology (included)

PRICE: \$2749.00 (complete package)

HIGHLIGHTS

- Everything you need in one package
- FireBridge Technology for extended range
- Easy to fly with many automated features
- High-quality video and photos







IN THE AIR

It is hard to say anything bad about the flying characteristics of the Phantom 4. DJI has had a number of years to get it right, and it has utilized that time well. The Phantom 4 Falcon Edition is a solid-flying quad that feels very stable in the air. The added feature of a solid video feed from the camera gives an additional sense of security to the pilot, which makes flying this quad all the more enjoyable.

Most people will start out in Positioning mode, using the GPS and Obstacle Sensing System to stabilize the quad automatically. Once you have a feel for the bird, switch to Sport mode to enhance the quad's maneuverability and gain 25 percent more speed. You lose the Obstacle Sensing System in this mode, so be careful and plan out your flight path. If you don't want to pilot the Phantom 4, use TapFly and just tap on the screen where you want the Phantom 4 to go. It will travel there using the Obstacle Sensing System to keep it clear of objects in the way. Last, ActiveTrack allows the pilot to select a subject that the drone will follow and keep it on the screen.



Above: Here's the complete package with everything neatly arranged in a durable case. **Below left:** The obvious external modifications are these matched dual heli-coil antenna at the top of the transmitter on their custom mount. **Below right:** The only hint of all the modifications inside is this small external cooling fan.



BOTTOM LINE

The DJI Phantom 4 Falcon Edition from Drone World is one of the best packages available for drone pilots looking to improve their aerial video/photography. The kit has everything you need for any flight, and the bulletproof video signal is a big confidence booster. If you are looking to get a new Phantom, this is the one you want. ✈

FireBridge Technology—and Why You Need It

While the modifications for the FireBridge Technology to the transmitter are obvious, there's way more to it than cool-looking antenna. Inside the transmitter are internalized custom Wi-Fi boosters along with a custom cooling system, all of which are within FCC tolerances. The only external hint of these modifications is a small cooling-fan grid at the bottom of the transmitter. All of these internal modifications operate using the internal battery and the factory charger, which is impressive in itself. The obvious modifications are the matched dual heli-coil antennae at the top. The antennae have a custom mounting that allows for easy access to the transmitter plugs, and they are attached using military-grade wiring.

Should you fly your quad out four to five miles? No! Having the ability to work at up to five miles, however, means that it will have a guaranteed signal within a one-mile range, providing absolute reception under even the most adverse conditions. FireBridge can penetrate through trees and fly out much farther distances than the stock Phantom 4 at low elevation. This added confidence is worth every penny to pilots who know that, when their quad is in the air, they will have a continuous signal throughout the flight. That type of security is priceless!

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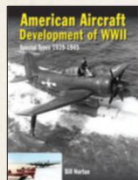
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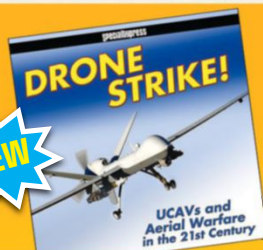
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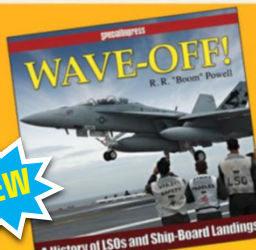


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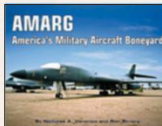


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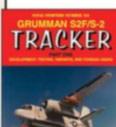
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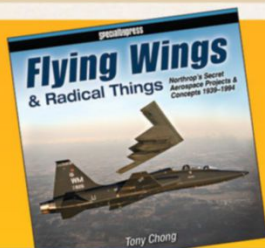
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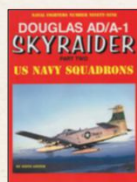
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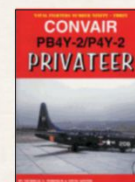
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CONSTRUCTION

BY PAT TRITLE



Though not a trainer, the Cessna 172 is a docile, easy-to-fly airplane. In flight the model is smooth, steady, and easy to control. With the flaps deployed, takeoffs are short and landings are slow and easy.

Cessna 172 Skyhawk

Build this 5-channel light-plane classic

four-place, single-engine private aircraft, the Cessna 172 is considered the most successful light plane ever built. First flown in 1955, the earlier models were straight-tail fastback models, and later variations were equipped with the now characteristic swept tail and wraparound rear-cabin window. The Cessna 172 found its way into military service as the T-41 Mescalero and was also used by the United States Border Patrol for surveillance along the U.S./Mexico border, so there are plenty of attractive paint schemes to choose from.

THE MODEL

My model is 1/8 scale and has a 53.5-inch wingspan. It utilizes conventional stick-and-tissue fuselage and tail-group construction, and the wing's easy-to-assemble egg-crate construction makes assembly quick, strong, and light. Though not overly large, the model has plug-in wing panels that are removable for easy transport and are held in place by magnets, so no tools are required to take the

model apart.

The battery and radio gear is easily accessed through a removable hatch on the bottom of the fuselage. And to make things simpler, a package of laser-cut wood and plastic parts is available from Manzano Laser Works (manzanolaser.com) for those who would prefer not to cut their own parts. The C172 is set up for 5-channel RC control using six submicro servos that include the standard flight controls plus functional flaps, making it the perfect candidate for small flying fields due to its slow and gentle flying qualities and short-field takeoff and landing capability.

Power is provided by a low-cost outrunner motor and a 2-cell LiPo battery, which will provide flight times in excess of 15 minutes.

BUILDING THE MODEL

Construction begins with the vertical and horizontal stabilizers, which are built directly over the plans. Because the stabilizers have an airfoil shape, use shims to center the leading and trailing edges on the ribs. Fit and glue

SPECIFICATIONS

Model: Cessna 172
Type: Sport scale
Scale: 1/8
Wingspan: 53.5 in.
Length: 38.75 in.
Weight: 25.6 oz.
Wing area: 390 sq. in.
Wing loading: 6.9 oz./sq. ft.

GEAR USED

Radio: JR XG8 transmitter w/ JR RG612BX receiver (jramerica.com); six E-flite S-75 servos (horizonhobby.com)
Motor: Suppo 2217/9 outrunner (altitudehobbies.com); 20-amp E-flite speed control w/ 3A BEC (e-flite-rc.com)
Battery: Venom 2S 2000mAh LiPo (venompower.com)
Propeller: APC 11x5.5E (apcprop.com)

blue foam or light balsa blocks to the bottom of the rudder, and sand to shape. The rudder and elevator are hinged using 5/32 x 1/2-inch strips of light CA hinge material. The hinges aren't glued in place until after the frames have been covered.

WING ASSEMBLY

Begin by pinning SM1 (the servo plate) in place

over the plan. Dry-fit all of the ribs onto the main and rear spars over the plan, and pin the assembly in place using the washout jig under R9 to support the outer ends of the spars. Glue each point of contact, followed by the leading edge. Build the flaps and ailerons in place along the wing assembly over the plans, then remove the assembly from the board and add the aileron servo and strut mounts; sand the assembly to shape. Hinge the flaps and ailerons as described in the stabilizer assembly. Cut and

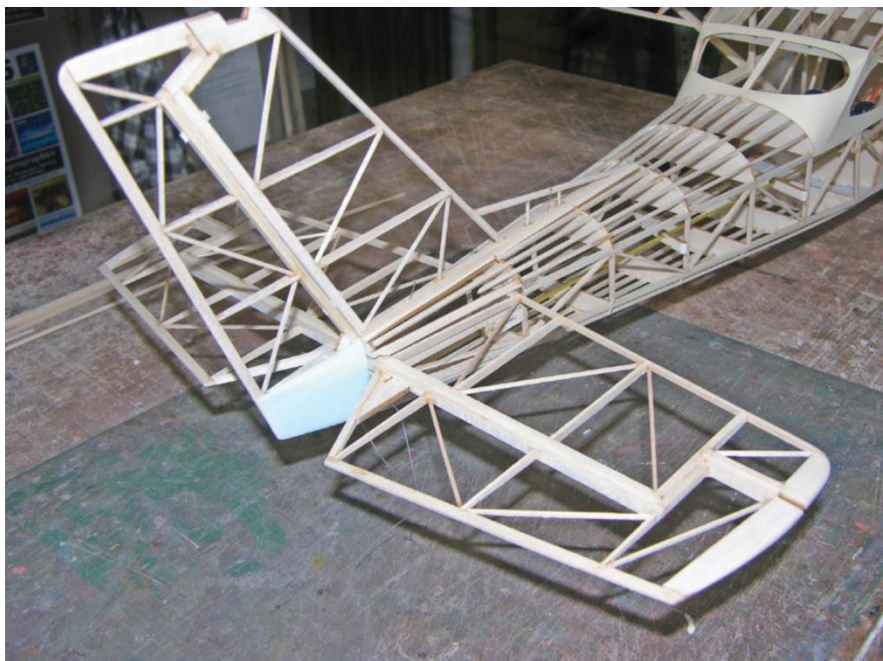
fit the brass joiner tubes to length, and glue them in place. Last, glue the flap and aileron servos in place using silicone caulk, and run the servo wiring out through the root rib. Make up the wingtip blocks from blue foam or soft balsa, glue the R9WT rib in place, and carve the tips to shape using the provided detail drawing. Glue the tips in place on the wing assembly.

FUSELAGE ASSEMBLY

Start by building the side frames over the

assembly drawing. Remove the frames from the board, align and glue B2 (the landing-gear mounts) in place on the inside of the left- and right-hand side frames. Bend the landing gear to shape, and glue it into the former assembly (4A/4B/4A). Join the frames, beginning with the upper-cabin formers and landing-gear assembly, taking extra care to ensure that the assembly is square. Then add the remaining formers to complete the basic assembly.

Fit and glue the servo mounts in place, install



A section of the aft fuselage former is removed to allow the horizontal stabilizer to be fitted into the fuselage.



The flap and aileron assemblies are built directly over the plans, along with the main wing assembly. The brass joiner tubes are glued in place after the wings are sanded to final shape.

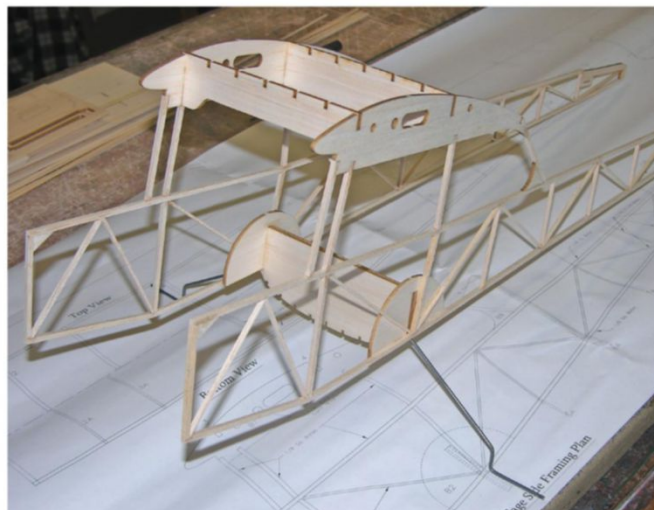
Materials List

Here's a list of wood sizes, material, and hardware you need to build the Cessna 172.

- 2 balsa sheets, 1/16 x 4 x 36 inches
- 1 balsa sheet, 3/32 x 4 x 36 inches
- 3 balsa sheets, 1/8 x 4 x 36 inches
- 1 ply, 1/32 x 3 x 8 inches
- 1 light ply, 1/8 x 3.5 x 13 inches
- 3 balsa sheets, 1/16 sq. x 36 inches
- 7 balsa sheets, 1/16 x 1/8 x 36 inches
- 3 balsa sheets, 1/16 x 3/16 x 36 inches
- 2 balsa sheets, 1/16 x 1/4 x 36 inches
- 18 balsa sheets, 3/32 sq. x 36 inches
- 1 balsa sheet, 3/32 x 1/4 x 36 inches
- 8 balsa sheets, 1/8 sq. x 36 inches
- 2 balsa sheets, 1/8 x 3/16 x 36 inches
- 1 balsa sheet, 3/16 x 1/2 x 36 inches
- 2 balsa sheets, 3/16 sq. x 36 inches
- 2 balsa sheets, 1/4 x 3/8 x 36 inches
- Blue foam or balsa block (wingtips and rudder fairing)
- 1 steel wire, 0.025 dia. x 36 inches
- 1 steel wire, 0.032 dia. x 36 inches
- 1 steel wire, 0.046 dia. x 36 inches
- 1 steel wire, 0.093 dia. x 36 inches
- 1 brass tube, 5/32 o.d. x 36 inches
- 1 aluminum tube, 3/16 o.d. x 36 inches
- 1 brass strap, 0.032 x 1/4 x 2 inches
- 1 nosewheel, 2 inches
- 1 pair main wheels, 2 1/4 inches
- 3 wheel collars, 3/32 inches
- 1 1/2 rolls Microlite
- 1 sheet white styrene, 0.010 x 6 x 12 inches
- 2 sheets acetate, 0.008 x 6 x 12 inches
- 2 servo Y-harnesses
- 2 servo extensions, 6 inches
- 2 servo extensions, 9 inches
- 1 Micro E/Z Connector



The flap and aileron servos are glued in place using silicone caulk.



The fuselage side frames are built directly over the assembly drawings and then joined vertically, beginning with the upper cabin formers and landing-gear assembly.

the servos, and install the elevator pushrod tube and rudder pull-pull cables. Build up the motor-mount assembly, and glue it in place. Bend the nose-gear strut wire to shape, build up the control horn, and assemble the nose gear into the overall mount assembly. Connect the pushrod to the servo arm using a Du-Bro E/Z Connector. Now that everything is in place,

add all the top and bottom stringers, and sand the fuselage assembly to final shape. Install the motor and speed control, and run the power leads into the fuselage. Make the cabin fairings from manila-file-folder material, and glue them in place to complete the fuselage assembly.

Build up the lift struts as shown in the provided detail drawings. Sand the struts to

an airfoil shape, then fit and glue the lower retention clips in place. Plug the wings into the fuselage and hand-fit the struts, then secure the outer retention clips to the struts.

ASSEMBLING THE PLASTIC PARTS

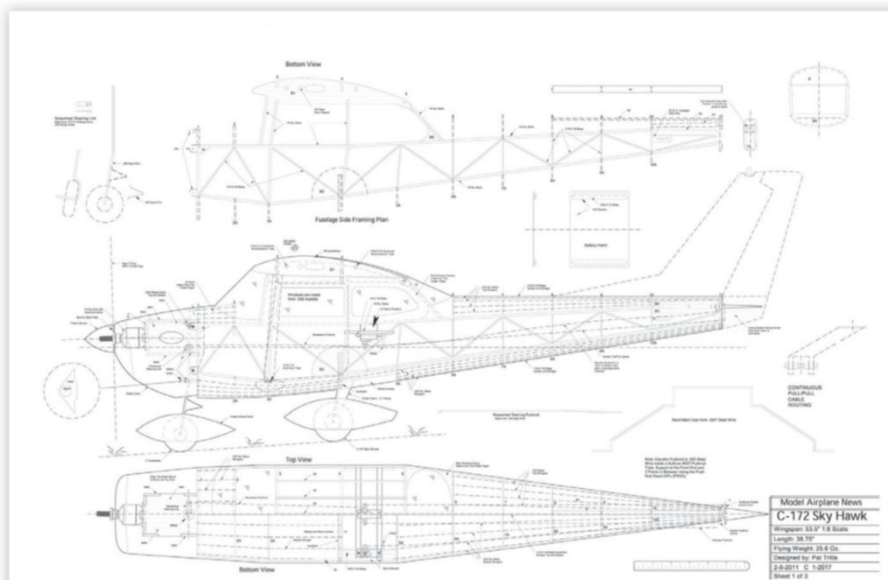
Build the cowl and wheel pants and fit them onto the fuselage assembly, but don't glue them in place until after final assembly. If you're new to assembling plastic wheel pants, go to patscustom-models.com/wheelpants.html for a complete tutorial. Assemble the cowl, trim as needed, and fit it to the fuselage with the motor in place and then secure it with the mounting screws left over from the flap and aileron servos. Build the battery hatch from balsa and styrene, using the detail drawing provided.

COVERING

Any of the lightweight iron-on coverings, such as Microlite or CoverLite, are well suited to these light structures. Before you begin covering, disassemble the model and do a final detail sanding to prep the assemblies for cover. Then apply the covering material per the manufacturer's recommendations, and add any desired paint and trim scheme. Make up all the cabin windows from clear acetate sheet. The windows can be glued in either on the inside of the paper fairings or on the outside; however, fitting them on the inside produces a much nicer-looking finished model. If you opt for the inside, start at the rear of the cabin and work your way forward to the windshield.

FINAL ASSEMBLY

Glue all of the hinges in place with white glue, such as Zap Formula 560 Canopy Glue. Plug the wing panels into the fuselage, and attach the lift struts. Remove the hatched section of former 11, and slip the horizontal stabilizer into the mount. Using the wing for reference, align



Cessna 172 | X0517A

Designed by Pat Tittle, this 1/8-scale Cessna 172 is easy to build and uses conventional stick-and-former construction and egg-crate wing assembly. It is lightweight and flies great. The model has a steerable nosewheel and functional flaps. Laser-cut and formed plastic parts are available.

WS: 53.5 in.; Power: Suppo 2217/9 outrunner; Radio: 5-channel; LD: 2; 3 sheets; \$27.95



To order the full-size plan, visit AirAgeStore.com.



With more than 43,000 aircraft made, the Cessna 172 Skyhawk is the most popular civilian aircraft ever produced. (Photo courtesy of Wikimedia Commons)

The Most Popular Aircraft of All Time

First flown in 1955, the four-seat, single-engine Cessna 172 Skyhawk is a high-wing, fixed-wing aircraft manufactured by the Cessna Aircraft Company, now part of the Textron. An offshoot of the Cessna 170 tail-dragger, the tricycle-gear 172 was an improved variant with a Continental O-300-A engine, and it featured larger elevators and a more angular vertical fin. The 172 was viewed as an overnight sales success, and more than 1,400 were built in 1956, its first full year of production. Further aesthetic improvements, beginning with the 1963 172D version and all later 172 models, included a lowered rear deck, which allowed an aft window. The airframe has been such a success that Cessna has not changed the configuration since then, except for updates in avionics and engines (including a Garmin glass cockpit in 2005). Production stopped in the mid-1980s but was resumed again in 1996, with the introduction of the 160hp-engine Cessna 172R Skyhawk. And in 1998, Cessna introduced a newer

180hp version, referred to as the Cessna 172S Skyhawk SP.

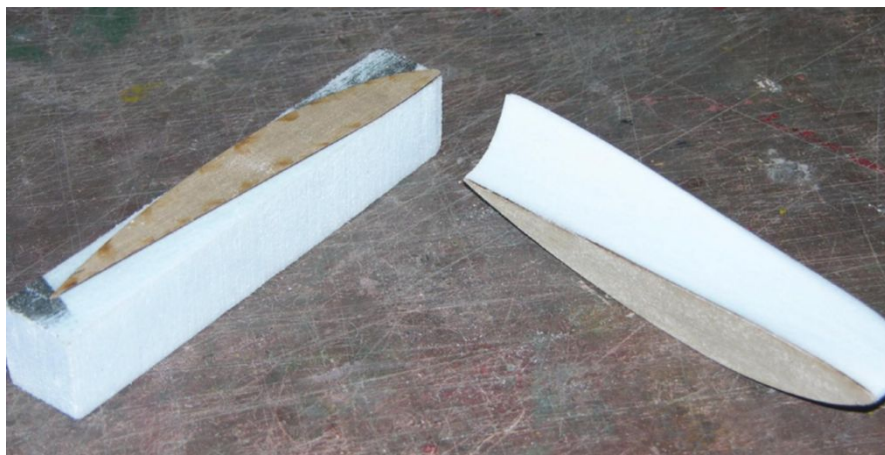
Further refinements followed, including an increase in power from 180 to 210hp, constant-speed propellers, additional fuel-tank capacity in the wingtip and baggage-compartment tanks, and landing-gear wheel pants to reduce drag. With more than 43,000 airframes produced, more Cessna 172 Skyhawks have been built than any other aircraft, making it one of the most successful in history.



The Cessna 172 went through several upgrades throughout its development, and its most distinct features are its rearview window and its sweptback vertical fin and rudder.

and glue the stabilizer in place. Align and glue the vertical tail in place, again using the wing for reference. Install the elevator pushrod through the cutout in the firewall, and secure it to the servo arm with a Z-bend. Then make another Z-bend at the stabilizer hinge line, align the elevator in the neutral position, and glue the control horn in place.

Install the rudder cables using the provided diagram. Run the cables into the fuselage, and tie them off to the control horn. Test the system to ensure that the rudder and nosewheel both move in the same direction. If they don't, swap sides by crossing the rudder cables (that will be a lot easier than changing the nosewheel linkage!). When everything is functioning properly, secure the cables to the control horn. Make up the aileron control rods from 0.032-inch-diameter steel wire. Make a Z-bend on one end, and slip it onto the servo arm. Make a Z-bend at the hinge line, align the aileron to the neutral position, and glue the control horn in place. To set up the flaps,



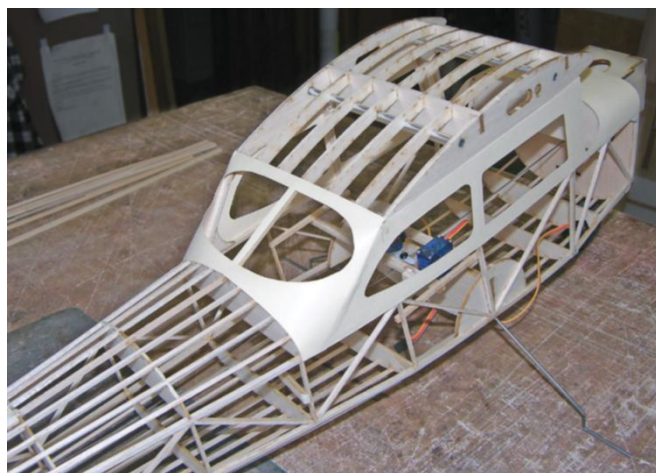
The Horner-style wingtips are carved from blue foam or soft balsa blocks.

position the servos to the full up position, then follow the same procedure as the ailerons to fit the pushrods. Set the controls for the throws called out for on the plans. The flaps will require

a bit of elevator-trim correction, so mix in a little downtrim at half and at full deflections. The final setup will be adjusted as needed when the model is flown. Then, with the flaps



The fuselage assembly is finished with the addition of the servos, mounts, and all the top and bottom stringers.



The window frames and fairings are made out of file-folder paper and glued in place around the cabin.



Access to the radio gear and battery is made through a hatch on the bottom of the fuselage.



The vacuum-formed plastic cowl is built up and fitted onto the fuselage, then trimmed to fit the motor used.



With all the framing and sanding done, the model is fully assembled to check for final fit and function while the internal components are still accessible.

in the up position, make the 0.010-inch-thick styrene-flap gap fairings, and glue them in place on the top of the wing. Install the wheels and pants, and reinstall the nosewheel into the motor-mount box. Attach the cowl, and add any desired details to complete the model.

Balance the model 2.3 inches from the wing leading edge at the root rib, using the battery to your best advantage. My model has been flown with a 2S 2000mAh LiPo and balanced correctly with the battery mounted on the back side of former 4A/4B/4A. The battery is secured to the former with some Velcro fastener. And with that done, the Skyhawk is ready to fly.

IN THE AIR

Though not a trainer, the Skyhawk is gentle, docile, and easy to fly. Control is crisp and

responsive, but it isn't the least bit twitchy when set up as shown on my plans. Power is more than adequate, but the model is not overpowered, though rarely does the throttle need to go much past half. The flaps are effective in slowing the model for landings, and when takeoffs are done at half flaps, the rollout is quite short. Takeoffs can also be done with full flaps, but due to the added lift, be prepared to push in a bit of down-elevator during the climbout.

Before your first flight, double-check the controls to ensure proper throw and direction of travel. To take off, slowly advance the throttle until the model is light on its gear, then lift off with just a touch of up-elevator. Keep the climb shallow, and when at a safe altitude, trim the model for straight and level flight with a comfortable cruise speed. To check the flap/

elevator trim, slow the model down a bit and pull the flaps down to the takeoff setting. If the model pitches up, more downtrim is needed; if it pitches down, some trim correction will need to be removed. After the takeoff settings have been determined, try slowing the model a bit more and go to the landing flap setting, where the same trim setup will apply.

Landing without flaps is not a problem, but the model will land more slowly with half flaps and slower yet using full flaps. Try a few stalls at altitude at both flap settings to see how the model handles in slow flight; once you get a feel for it, you can start experimenting with full- and half-flap landings. Where the model really shines is with touch-and-go landings. Fly the approach with full flaps, and when the mains touch down, go to half flaps, power up, and you're off and running again. Above all, enjoy the ride. ✈



The Cessna 172 is all buttoned up and ready for her maiden flight.

Product Watch

MINI REVIEWS OF EDITORS' FAVORITES



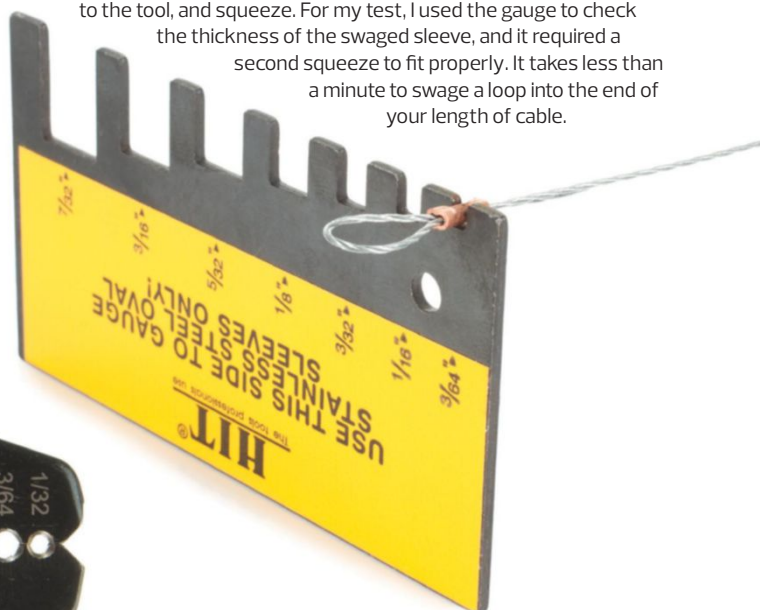
Balsa USA 1/4-Scale Deluxe Nicopress Starter Set

If you know the name Balsa USA, chances are you have at least a passing interest in World War I airplanes and perhaps, more specifically, kits for these vintage RC dogfighters. Many of these classic warbirds are biplanes, and some require rigging wires to add strength to the airframe. If you are simply adding flying wires to your model for show, then you can make them as simple as possible as the airframe won't be relying on the rigging wires for structural integrity. But if you are building larger 1/4- and 1/3-scale airplanes, many of these do require functional rigging. You have to install them correctly so that you don't suffer an in-flight failure of a wing panel or tail surface. That's where the new 1/4-scale Deluxe Nicopress Starter Set comes in.

The great thing about using this system is that the cables for both flying wires, tail rigging, and control surface pull-pull systems look correct and very close to scale—an added bonus for the static judging score. Included in the package are the swage (crimping) tool, a multiple-size sleeve gauge, 36 copper oval sleeves, and 30 feet of 1/32-inch braided-steel cable. The instructions show the specifications for the proper number of crimps to use for each sleeve based on the cable size you are using. For the included 1/32-inch cable, a single crimp is needed per sleeve, which is also the same for 3/64- and 1/16-inch cables. Two

crimps are required for 3/32-inch cables, and three are required for 1/8-inch cables. The tool included in the 1/4-scale Starter Set has jaws for 1/32-, 3/64-, and 1/16-inch cable sizes.

The tool is easy hold, and it also has two cutting sections one on either side of the jaws. To produce a swaged sleeve, simply slide the end of the cable into one of the openings in the sleeve, bring the cable back around, and insert the end back into the other opening to form a cable loop. Place the sleeve into proper section of the tool's jaws, keeping it 90 degrees to the tool, and squeeze. For my test, I used the gauge to check the thickness of the swaged sleeve, and it required a second squeeze to fit properly. It takes less than a minute to swage a loop into the end of your length of cable.



If you want to enjoy your giant-scale WW I biplanes without fear of a rigging wire letting go during flight, this Nicopress Starter Set is a great way to get the job done. Priced at \$47.30, it's an excellent value.—Gerry Yarrish
balsausa.com

Sullivan Products Ball Connectors

When you build a model airplane and install all the linkages required for the various control functions, the strength and quality of these connections greatly affect the life of your airplane. Simple plastic clevises might be OK for your run-of-the-mill foamie park flier, but for a more involved, high-performance aircraft, you need secure and strong linkage connectors. Sullivan Products has been producing rugged, quality hardware for years, and when it comes to clevises, it's hard to beat its steel Gold-N-Clevises with retaining clips. Taking control security to the next level, Sullivan has evolved its line to include the extremely well-engineered ball connector with a locking sleeve.

Color coded for easy identification, these ball connectors are available in three basic sizes: 4-40 (blue), 2-56 (red), and 2mm (green) to mate with threaded wire pushrods (also available from Sullivan). These connectors are based on strong ball links that can be easily threaded into your servo arms and control horns, or used with your engine's throttle arm. A heavy-duty 3mm (gold) version is also available. These ball connectors also provide flexible geometry by allowing the pushrod to move and pivot if needed during operation while holding the locking sleeve securely in place, eliminating the chances of the linkage coming apart. The locking sleeve is spring loaded, so besides providing a bulletproof connection, it is also extremely easy to release by hand when you want to. Lots of people think these connectors are good only for throttle linkages, but I have found them equally useful for flaps, ailerons, rudder, and elevator linkage connections as well. Easy-to-remove linkages are great for performing maintenance or repairs. Prices range from \$5.99 to \$7.69, depending on size.—Gerry Yarrish
sullivanproducts.com



The Sullivan Ball Connectors are available in four sizes of threaded steel pushrods and are spring loaded for quick and secure attachment.

Final Approach

BY JOHN REID

FUTURE TECH:

Panasonic's BalloonCam

At this year's CES 2017 in Las Vegas, Nevada, I was looking over Panasonic's new GH5 camera—an update to the popular GH4 that's used on many large drones—and was directed to look up and check out Panasonic's new lighter-than-air vehicle: the BalloonCam. Filled with helium, this blimp is powered by four internal electric motors spinning four well-protected props on the balloon's centerline. Air is directed out the bottom by controllable vents, which provide directional control. The 10-foot diameter BalloonCam is 5 feet high, can carry a maximum payload of 4.5 pounds, and has a flight duration of about an hour. The long flight time can be attributed to the buoyancy of the balloon as the motors don't need to run constantly to keep it airborne.

The BalloonCam is billed as an innovative entertainment solution for stadiums and other large venues. On the bottom center of the balloon is a 360-degree 4K camera that sends panoramic video to an internal, built-in projector that displays it on all sides of the balloon, creating an interactive performance with the audience. The camera has automatic luminance-level and color-temperature compensation so that the video feed is easy to see in any lighting. The live feed projected on the inside of the drone creates dynamic aerial footage that can be safely flown close to an audience. In the Panasonic booth, the BalloonCam had terrific audience participation, with people constantly waving and milling around to see their projection on the side of the drone.

In the near future, expect to see the BalloonCam at indoor events such as concerts, sporting games, and conventions. In addition, a venue can program in advertising or notifications to appear in between live broadcasts. The BalloonCam is one very cool way to use RC technology. ✚

As you can see, I am projected up there on the balloon. There is about a half-second delay on the projected image and the action on the ground.



Photo by Dan Unger

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